CAL RIPKEN, SR. Foundation

TRANSFORM COMMUNITIES
CHANGE KIDS' LIVES

Ripken Foundation STEM Center

Curriculum Guidebook

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INTRODUCTION

INTRODUCTION

ABOUT THE CAL RIPKEN, SR. FOUNDATION

During his 37-year career with the Baltimore Orioles organization, Cal Ripken, Sr. taught the basics of the game and life to players big and small. After he passed away, his sons Cal and Bill recognized that not every child is lucky enough to have such a great mentor and role model. In this spirit, the Ripken family started the Cal Ripken, Sr. Foundation, a national 501(c)(3) nonprofit organization, in 2001.

By teaching kids how to make positive choices no matter what life throws at them, the Cal Ripken, Sr. Foundation strives to help underserved youth fulfill their promise and become healthy, self-sufficient, and successful adults.

ABOUT THE CAL RIPKEN, SR. FOUNDATION STEM PROGRAM

The Cal Ripken, Sr. Foundation provides programs, resources, training, and support to community-based youth organizations across the country that directly impact the lives of underserved kids. When it comes to the fields of Science, Technology, Engineering, and Math (otherwise known as STEM), we have created a program that makes STEM activities and learning easy for mentors at community-based youth organizations to implement.

We have developed Ripken Foundation STEM Centers to facilitate STEM learning with youth partners nationwide. Each Ripken Foundation STEM Center is equipped with this STEM curriculum guidebook paired with STEM Center products and activity kits which provide a comprehensive, experiential learning environment for kids. The activities in the guidebook are designed to offer mentors many ways to teach critical thinking and problem-solving skills, all while having fun.

GUIDING PRINCIPLES OF THE CAL RIPKEN, SR. FOUNDATION

Cal Ripken, Sr. was a player, coach, and manager in the Baltimore Orioles organization for nearly four decades. He developed great players and, more importantly, great people through his style of coaching which we use as our guiding principles at the Foundation. No matter what you are teaching, you can use these four key ideas as your guide:

Keep It Simple

Lessons on the field and in life are best learned when presented in a simple manner. Teach the basics and keep standards high.

Explain Why

By helping kids understand the connections between everyday decisions and real-life outcomes, we can help them make smarter choices for brighter futures.

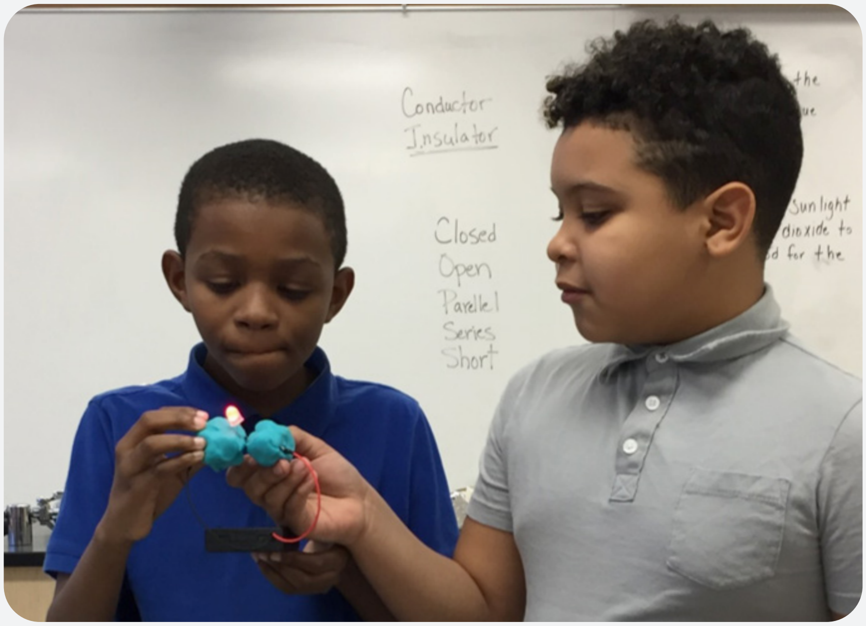
Celebrate The Individual

When kids are encouraged to be themselves, respected for their opinion, and are encouraged to share it, they are more likely to have a higher self-esteem and feelings of self-worth.

Make It Fun

If kids aren't paying attention or participating, how much are they learning? Whether it's using a game to teach a concept or motivating kids with a little friendly competition, keeping kids engaged is essential.

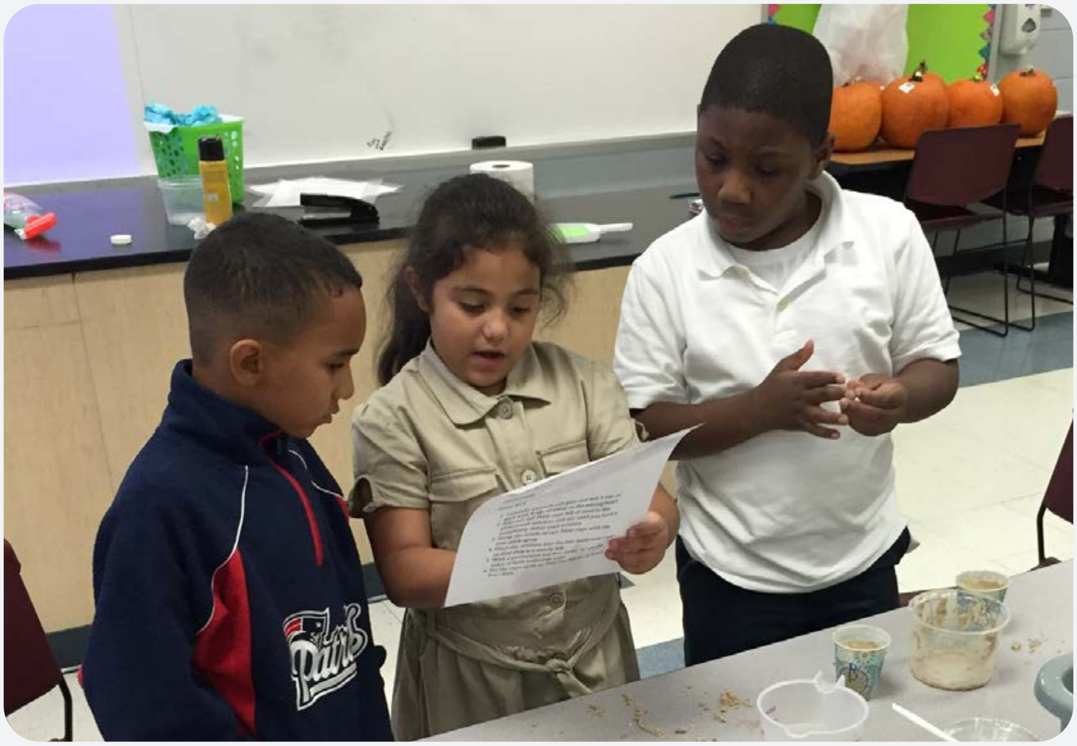
Want to hear Bill Ripken explain the guiding principles of the Foundation?
Go to **http://www.RipkenFoundation.org** *and sign up for a free account today!*



KEEPING KIDS ENGAGED

Here are some tips to help you structure activities that keep kids engaged, excited, and coming back:

- **Have a plan**
- **Keep activities structured**
- **Provide feedback**
- **Encourage, encourage, encourage**
- **Allow kids opportunities to collaborate and learn from each other**
- **Set achievable goals**
- **Let kids be silly – they're kids!**
- **Use short time increments and reminders**
- **Rotate activities frequently**
- **Let kids have input in the activities they like best**
- **Stay consistent and create routine**
- **Affirm kids when they do well**



EDUCATIONAL PRINCIPLES BEHIND STEM EDUCATION

EDUCATIONAL PRINCIPLES BEHIND STEM EDUCATION

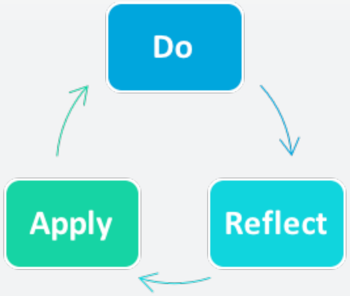
Ripken Foundation STEM Centers allow kids to learn and explore their curiosities without the confines of standardized lesson plans and testing. This curriculum guidebook is designed to give you background on the supplies we have provided, along with a set of lessons to enrich your mentoring program.

To help you curate a successful STEM program, we have provided a selection of tools that will strengthen your skills as a STEM mentor. Having these tools in your back pocket will enrich your understanding of the best practices which will enable you to teach important principles while having fun! Remember, some of these tools youth have already encountered in the classroom, so using them in afterschool mentoring programs will reinforce the skills and instill the confidence kids need to excel in STEM subjects, leading to careers in related fields.

HANDS-ON LEARNING

Hands-on learning is a key component of the Ripken Foundation STEM Centers. By having kids actively participating in a hands-on learning experience, you foster skills of inquiry, self-discovery, and problem solving, all while learning science, technology, engineering, and mathematics concepts.

The Experiential Learning Model shows how learning occurs with hands-on experiences. This model, based on the work of D.A. Kolb (1984), works on three basic principles: Do, Reflect, Apply.



Do:

Instruct the kids to conduct an activity. Kids are directly involved in the process by conducting experiments, designing solutions, and testing out ways to answer questions.

Reflect:

Ask questions to help the kids process the experience they just had. The questions offer a chance to delve deeper into the activity and understand concepts they can take away from the experience.

Apply:

Discuss other ways they can use the skills learned with other activities and experiences. The skills developed with one activity transfer to many different applications.

For example – you want your kids to build a garden. They learn how to sow seeds and care for plants, but they also learn how to plan ahead and use resources wisely. These skills developed in the garden will apply on their next project building birdhouses and beyond.

INQUIRY-BASED LEARNING

The Inquiry-based learning process allows kids to learn and grow in a supportive environment that gives them the opportunity to explore their curiosities through facilitated activities that incorporate "free play." Lessons usually begin with an introduction of concepts providing the educational background for activities. You can provide parameters and limitations such as time, budget, limited supplies, real world applications, etc. to give a context for the activities they are about to complete. After providing constructs, task kids with an open-ended challenge that allows them to explore and learn as needed within the constructs. Inquiry-based learning provides some structure for the kids on the front end, while allowing for the kids to arrive at a solution on their own or as a group.

For example – you task the kids with building the tallest tower they can in 10 minutes using only a limited number of index cards and straws. You provided the time and materials constraints, as well as gave them a goal, but left the design, use of materials, and actual construction up to the kids.

ENGINEERING DESIGN PROCESS

The Engineering Design Process (EDP) is a tool to assist with facilitation of problem solving. Children are presented with a scenario or problem, and they follow the steps of the engineering design process to imagine, create, and improve upon a solution to the issue at hand.

To help put this in context of classroom facilitation, we have created an example problem: Ellie and Henry are trying to grow three tomato plants. All three plants need to get water at the same time, but they only have one watering can. The six steps to the Engineering Design Process are as follows:

Ask:

Define the problem to address.

Scenario: We need to water three plants with one watering can.

Imagine:

Conceptualize and brainstorm ideas of possible solutions.

Scenario: How can we have the water come from one can but go three different places?

Plan:

Draw out sketches to visualize ideas including notes for assembly and constructing a model.

Scenario: Henry sketched out a picture of possible contraptions to add to the watering can. Ellie then built a working model based off Henry's drawing.

Test:

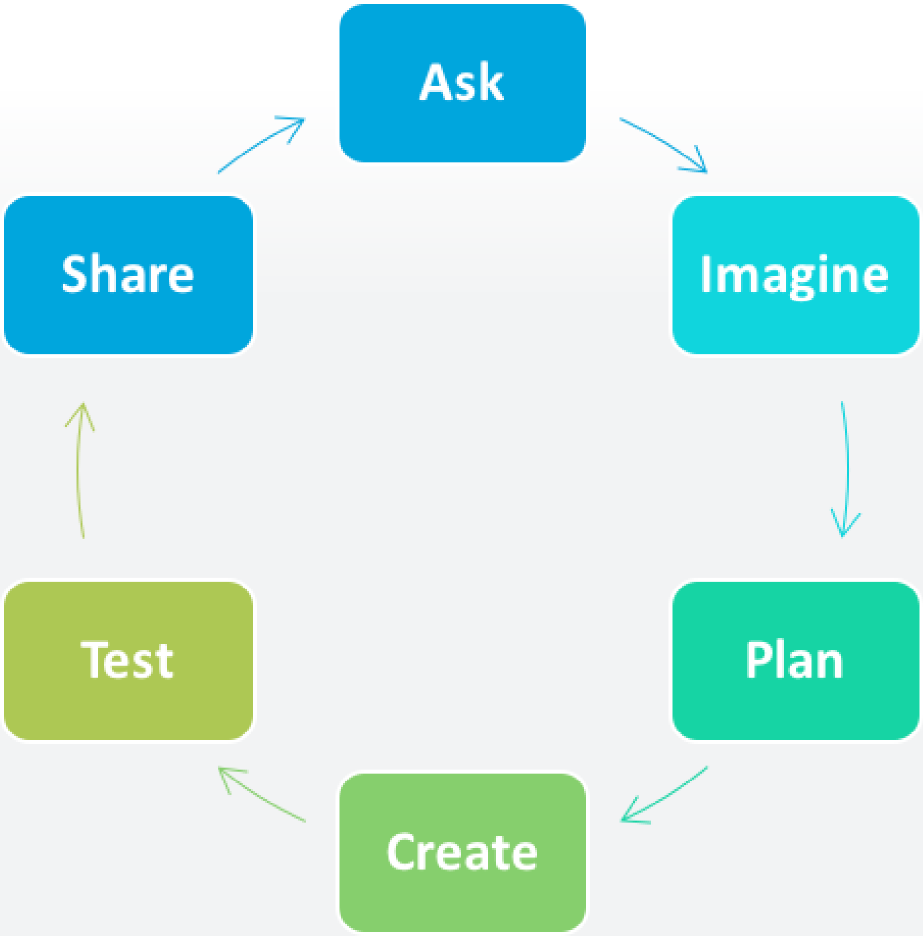
Conduct testing to determine if the plan meets the needs and solves the problem. Testing can identify improvements that need to be made and kids can go through the EDP until they are happy with a solution.

Scenario: Henry and Ellie tested their design to see if it worked. It didn't work, so they looked at the drawing and modified their model until it did what they wanted!

Share:

Engineering is a collaborative process. Kids can work in groups to create plans together, or they can offer feedback at the end.

Scenario: Ellie and Henry shared their design with their classmates, so everyone could use it and got feedback on how to make it better.



SCIENTIFIC METHOD

The Scientific Method is a process used to conduct science experiments through a logical process of problem solving and observation to help answer a question. The questions can be as simple or as complicated as you would like. Some experiments solve problems while others simply exist to satisfy a curiosity. The scientific method helps us with these questions through a step-by-step process to gather facts and arrive at an answer.

To help explain, we will follow up with Ellie and Henry's plants. They water them every day, but their plants are wilting and not growing. Ellie wants Henry's help to figure out why their plants are not growing.

Purpose

- State the problem or what you want to discover.
  - What is the question the experiment will address?
  - *The plants are wilting even though Ellie and Henry water them every day, why is this happening?*

Research

- Make observations about an issue or situation.
  - What is already known? What are you observing?
  - What potential causes of the problem can you rule out?
  - *Ellie thought, "My plants get water and sunshine, but what if I am watering them too much?"*

Hypothesis

- Predict the outcome to the problem in a testable statement.
  - Create a statement that predicts the solution - usually written as an "if...then" statement.
  - Use the research and observations to make an educated guess as to what will happen.
  - *Henry poses "If we only water our plants once a week, then they will grow?"*

Experiment

- Develop a procedure to test the hypothesis.
  - Define a step-by-step plan to follow to ensure consistency in carrying out the testing.
  - *Henry and Ellie plan to use their three tomato plants. For one month, they will water one every day, one three times a week, and one, once a week. Ellie and Henry observed their plants twice a day and measured the height of each plant.*

Analysis

- Record the results of the experiment.
  - Keep track of the testing results and interpret them.
  - *At the end of the month, Ellie and Henry saw the plant that was watered every day did not grow, the plant watered three times a week grew one inch but was still somewhat wilted, and the plant watered once a week grew three inches and was standing tall.*

Conclusion

- Compare hypothesis to the results of the experiment.
  - Did the results of the experiment support the hypothesis? Why or why not?
  - *Ellie and Henry changed their plans and now only water their plants once per week as the experiment supported their hypothesis that watering the plants less than once per day would make their plants grow.*

WHAT IS A RIPKEN FOUNDATION STEM CENTER?

WHAT IS A RIPKEN FOUNDATION STEM CENTER?

We at the Cal Ripken, Sr. Foundation continue to help underserved kids through developing new and relevant programs. In keeping with that goal, we have created the Cal Ripken, Sr. Foundation STEM Program. According to a recent Harvard study, "there is widespread recognition of the need for literacy and proficiency in Science, Technology, Engineering, and Mathematics (STEM) to navigate the modern world. Furthermore, there is an urgent national priority to transform STEM learning and engagement in order to meet the nation's need for a STEM-skilled workforce." One of our priorities is giving underserved youth in disadvantaged neighborhoods the opportunity to participate in STEM programs.

Ripken Foundation STEM packages include:

PRODUCTS

Organizations that implement the Ripken Foundation STEM program will receive a selection of materials to enhance STEM learning with their kids in the form of STEM Center products and STEM Kits.

RIPKEN FOUNDATION STEM CURRICULUM

This curriculum accompanies the Ripken Foundation STEM Center products, providing guidance on use of the products provided, as well as offering lessons to use with the kids and products.

RIPKEN FOUNDATION PORTAL

Our online portal offers digital copies of our curriculum as well as other resources for mentoring youth.

To download additional copies of the Ripken Foundation STEM curriculum, supporting files, and other educational materials, register for a FREE account at **http://www.RipkenFoundation.org**

PRODUCT GUIDE

Each Ripken Foundation STEM Center will receive a set of STEM equipment, along with a STEM Kit.

RIPKEN FOUNDATION STEM CENTER EQUIPMENT

The Ripken Foundation provides a variety of products to foster STEM learning in our Ripken Foundation STEM Centers. We work with our program partners to select products for their specific needs. Here is a list of some of the products available to each center:

3D Printer:

Centers receive a 3D printer capable of bringing digital, 3-dimensional models to life! Several spools of printing filament and a replacement nozzle are also included.

Computers:

Each Center has a choice of computers to meet their needs. Some of the models include: Notebooks, Chromebooks, or laptops.

Furniture:

Centers can receive up to: 28 Flavor Stackable Chairs, seven Elemental Clover Tables that seat up to four students each, and one workbench.

The Ripken Foundation STEM Kit includes fun and captivating activities that teach STEM concepts that cater to a variety of ages. The Ripken Foundation STEM Kits could include:

- **Bee-Bot**
- **Code Hopper**
- **littleBits**
- **Makey Makey**
- **Ozobot**
- **ROK Blocks**
- **Snap Circuits**
- **Squishy Circuits**
- **LEGO® Coding Express**
- **LEGO® WeDo 2.0**

BEE-BOT

OVERVIEW

Bee-Bot is a programmable robot designed for young children to teach counting, sequencing, coding, and problem-solving. Kids use the buttons to input commands telling Bee-Bot a sequence of actions to perform. Bee-Bot is rechargeable and comes ready to use right out of the box so with a little bit of exploration, kids can use Bee-Bot right away. Bee-Bot plays built-in sounds, but these can be muted with a switch on the bottom of the device. Kids can enter up to 40 commands, then press "go" and watch Bee-Bot in action!

PRODUCT SPECIFICS

Bee-Bot kits include:

- **6 Bee-Bot Robots**
- **1 Community Mat**
- **1 Card Mat**
- **1 Docking/Charging station**

MENTOR NOTES

To enhance cross-curricular programming, Bee-Bot can be used in conjunction with mats with pictures of the alphabet, numbers, coins, or other objects to have kids spell words, add up coins to a target amount, or navigate a town from one store to another. Bee-Bot offers mats for sale on their website, as well as accessories and curriculum.

Bee-Bot moves in 6-inch steps and 90-degree turns and works on a variety of surfaces, so the official mats are not required for use. Groups can construct their own versions of the mats using masking tape on the floor, or other items that create a physical or visual barrier for kids to program Bee-Bot to avoid.

Command cards are another way to enhance the use of Bee-Bot. These cards have directional arrows that kids can place in a specific order to enter as a sequence for Bee-Bot. These cards help visualize the coding, and kids can easily troubleshoot if they encounter an issue.

ONLINE RESOURCES

- **https://www.terrapinlogo.com/beebot.html**
  Bee-Bot main website
- **https://www.terrapinlogo.com/products/books-curriculum/bee-bot-lessons/beebot-lessons-online.html**
  Bee-Bot Curriculum available for purchase (not required)

CODE HOPPER

OVERVIEW

Code Hopper from Mindware, is a game that uses interlocking foam tiles to teach decision making, and basic coding and sequencing concepts through gameplay. Blocks have words, pictures, commands, or questions on them to help kids learn input and output through logic and flow charts. Simple actions like "Kick your leg" and decisions such as "Do you see a circle?" each lead children down different paths and help build a foundation for STEM success. The kit also includes a parent guide with definitions of coding concepts.

PRODUCT SPECIFICS

Code Hopper kits include:

- **12 two-sided mats**
- **Parent guide**

MENTOR NOTES

Code Hopper is for children ages 3 and older with instructions on how to use the kit in the Parent Guide. There are activities provided in the kit that introduce preschoolers and elementary-age children to computer coding.

ONLINE RESOURCES

- **https://www.mindware.orientaltrading.com/code-hopper-a2-68513.fltr**

LITTLEBITS

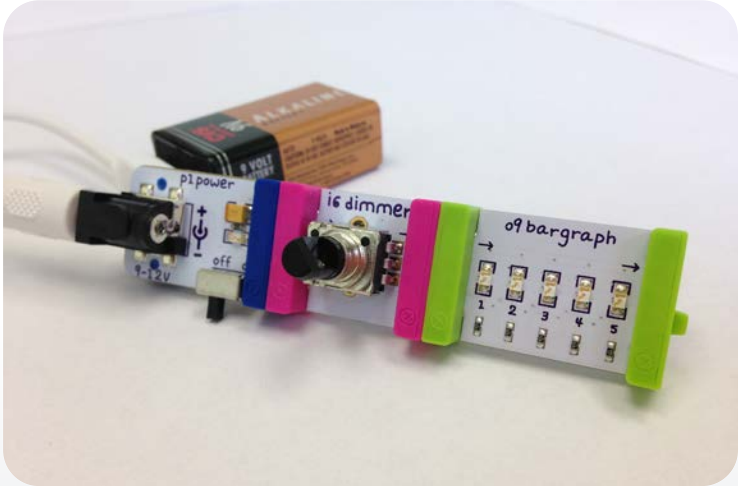
OVERVIEW

Often described as electronic building blocks, littleBits are easy to use educational tools that teach critical thinking and problem-solving through engineering and design. The kits are comprised of multiple electronic components (called bits) that each serve a specific function. The bits are color-coded and snap together using magnets making it fun and easy to use for kids and adults alike! littleBits comes with directions for assembling several projects which are easy to follow. The STEAM (Science, Technology, Engineering, Art + Design, and Math) Education Class Pack comes with lesson plans and resources to use in an educational setting.

PRODUCT SPECIFICS

littlebits Kits includes:

- **8 STEAM Class Packs**
- **littleBits and accessories**
- **Introduction and littleBits Basics Guides**
- **Invention Guidebook tied to the Next Generation Science Standards (NGSS) and Common Core Standards**



MENTOR NOTES

The materials are easy enough for elementary-aged children to use, but complex enough to allow high schoolers to create and explore. There are activities provided in the Teacher's and Student's Guides that come with the STEAM Class Pack, but there are many other lessons found on the littleBits educator's community website. You can sign up for a free account and gain access to many resources and ideas for using littleBits with your kids.

ONLINE RESOURCES

- **http://littlebits.com/**
- **http://littlebits.com/education**
- **http://littlebits.com/education/resources**

MAKEY MAKEY

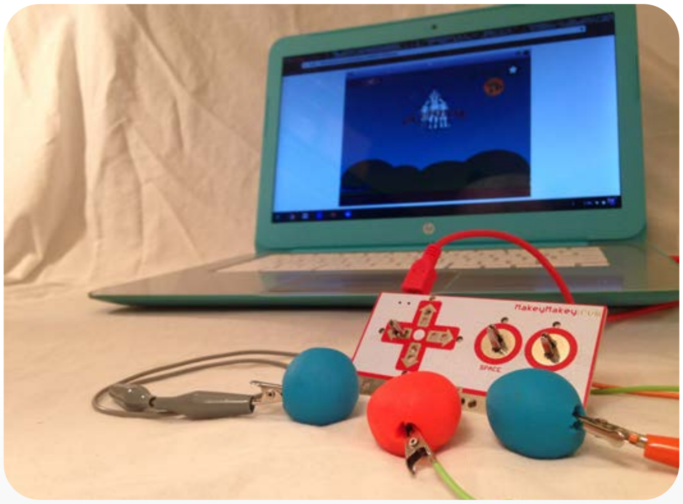
OVERVIEW

Makey Makey is a computer chip that you can affix to any computer, and it will act as a keyboard, game controller, or other controlling device. Kids can play games, play a banana piano, and other neat activities, all while learning basic circuitry. Kids can also go as deep as applying it to coding and programming lessons. Makey Makey is ready to use right out of the box, so just plug it in and start the fun!

PRODUCT SPECIFICS

Makey Makey Kit includes:

- **1 STEM Class Pack**
- **12 Makey Makey Chips**
- **Connecting wires**
- **USB computer connecting wires**
- **Graphite pencils optimized for use with Makey Makey**
- **Organizing carrying case**
- **Getting started guides**



MENTOR NOTES

Makey Makey has a wide offering of online resources available to mentors. The Makey Makey website has instructions for some of the more popular projects such as banana bongos or play dough game controller. Makey Makey has also created an educational website where mentors from around the world can contribute and share ideas and lesson plans. There is also an online forum to ask questions and get ideas and insight on ways to use Makey Makey with your kids. Makey Makey pairs well with Scratch, a visual-based programming language. Using Scratch, kids can create colorful games and animations to use with their Makey Makey.

ONLINE RESOURCES

- **http://makeymakey.com/**
- **http://makeymakey.com/how-to/classic/**
- **http://makeymakey.com/education/**
- **https://labz.makeymakey.com/dashboard**
- **https://scratch.mit.edu/**

OZOBOT

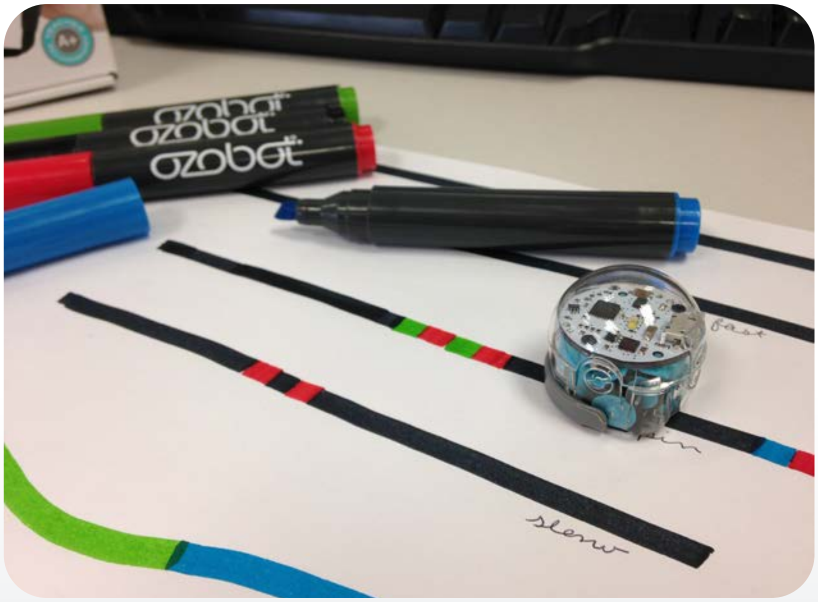
OVERVIEW

Ozobot is a programmable robot that uses simple concepts to teach coding and programming basics. Using markers, kids can simply draw a course and the robot will follow! By placing specific sets of colors along the course, the robot will read the colors and behave in a predetermined way. The robots can also be programmed on a computer using Blockly, a visual-based computer programming language.

PRODUCT SPECIFICS

Ozobot Kit includes:

- **1 Ozobot Evo Class Pack**
- **12 Ozobot Evo Robots**
- **Multi-port chargers**
- **Sets of markers**
- **Tip sheets**
- **Teacher's guide**
- **Storage boxes**



MENTOR NOTES

Ozobot's Classroom Kit comes with some lessons and classroom resources. Ozobot has an online website that provides mentors access to additional resources such as lesson plans and activities. Mentors can also submit materials to share with others on how they use Ozobot with their kids.

ONLINE RESOURCES

- **http://ozobot.com**
- **http://ozobot.com/stem-education/**

ROK BLOCKS

OVERVIEW

ROK Blocks are a reusable set of prototyping tools that allow kids to build and create 3D models of almost anything they can imagine. This kit is a new approach to building blocks, which allows for building things in three dimensions. The variety of the pieces and their durability make this a versatile product that meets many different programmatic needs.

PRODUCT SPECIFICS

ROK Block Kits includes:

- **6 ROK Blocks Mobile STEM Labs**
- **Stackable cases which hold various pieces and parts**

MENTOR NOTES

Kid Spark Education has an online resource center with many different lessons available for download at no cost. These lessons cover a variety of different STEM topics, and even include 3D Printing. The lessons and resources are available for different age and grade levels.

ONLINE RESOURCES

- **https://kidsparkededucation.org/**
- **https://kidsparkeducation.org/curriculum**

SNAP CIRCUITS

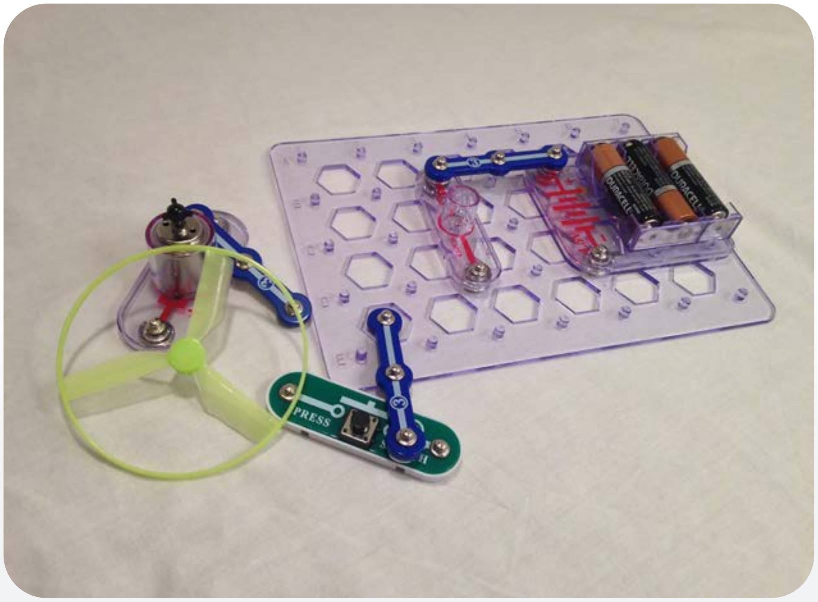
OVERVIEW

Snap Circuits from Elenco are a fun learning kit that teaches the basics of circuitry and electronics. The kit is comprised of different pieces that can be snapped together (like buttons) to create circuits which turn on lights, fans, radios, and other fun components! The kits are easy to use and assemble, and each comes with directions on how to put together different circuits. The kits can be combined to make larger circuits.

PRODUCT SPECIFICS

Snap Circuits kits include:

- **12 Snap Circuits Jr.® Education 100 Experiments Kits, including:**
    - **- Wire**
    - **- Resistor**
    - **- Speaker**
    - **- Motor**
    - **- LED**
    - **- Switch**
- **Project instruction guide**
- **Student Guide**
- **Teacher Guide**



MENTOR NOTES

Snap Circuits allow kids to learn the concepts of electronics through easy-to-use components. The activities in the guide provided offer different projects that range in complexity from simply turning on a light to complex circuits using resistors and switches. One realistic feature of Snap Circuits is the use of actual electrical symbols on the products themselves as they would be seen in a schematic drawing or circuit diagram. Also, some of the pieces are made with clear plastic, so the internal wiring can be seen.

ONLINE RESOURCES

- **http://www.snapcircuits.net/**

SQUISHY CIRCUITS

OVERVIEW

Squishy Circuits teach circuitry and electronics by using conductive dough, LEDs, and other components using a fun and easy-to-grasp product. Using conductive and insulating dough, Squishy Circuits can create any shape imaginable while still teaching circuitry and electronics.

PRODUCT SPECIFICS

Squishy Circuits Kits include:

- **1 Group Kit (includes enough components for a class), including:**
  - **- Battery holder**
  - **- LEDs (various colors)**
  - **- Piezoelectric Buzzer**
  - **- Motor with fan blades**
  - **- Switch**
- **2 Dough kits**

***Note:** *The dough is a consumable product will need replacing periodically. You can purchase more dough from the Squishy Circuits store, or make it using recipes included with the kit or found online.*

MENTOR NOTES

Kids love how easy this product is to use. The dough provided works well, but there are alternatives as it is a consumable product and will need occasional replenishing. One option is to use commercial play dough as a conductive dough with modeling clay as the insulating dough. There are also recipes found online as well as in the kit to make your own doughs.

There are no official lessons provided from Squishy Circuits. You can find project ideas in the quick start guide and on the Squishy Circuits website.

ONLINE RESOURCES

- **https://squishycircuits.com/**
  Official site with store to purchase additional supplies.

LEGO® CODING EXPRESS

OVERVIEW

Taking the train set to the next level, the LEGO® Coding Express uses large, colorful bricks to teach STEM concepts such as cause and effect, and basic coding principles like sequencing and looping. Special bricks are placed along the train tracks to prompt the train to perform a specific action such as play a sound, turn on a light, or change direction. In order to introduce STEM at an early age, the LEGO® Coding Express is a kit aimed at kids two to five years old.

PRODUCT SPECIFICS

LEGO® Coding Express kits include:

- **LEGO® DUPLO® bricks**
- **Battery-powered train**
- **Getting Started guide**

MENTOR NOTES

The LEGO® Coding Express can be used on its own, or you can deepen and enhance the experience using the LEGO® Coding Express app. The app is available on Android and Apple iOS operating systems. LEGO® Education has lesson plans available to facilitate learning.

LEGO® Coding Express requires four AA batteries for each train chassis.

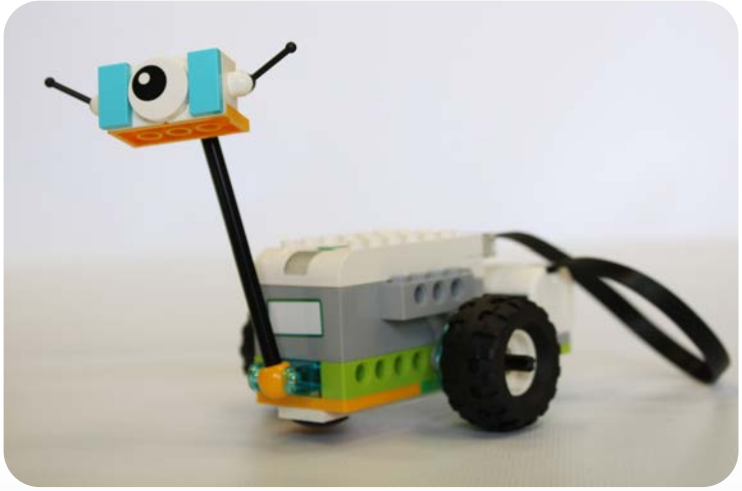
ONLINE RESOURCES

- **https://education.lego.com/en-us/support/preschool/coding%20express**
  Overview of LEGO® Coding Express resources including lesson plans, teachers guide, and building instructions
- **https://education.lego.com/en-us/lessons**
  LEGO® Education lesson plans
- **https://education.lego.com/en-us/downloads/early%20learning/software**
  LEGO® Coding Express App Downloads – available for Android and Apple iOS platforms

LEGO® WEDO 2.0

OVERVIEW

LEGO® WeDo 2.0 combines the standard LEGO® brick with motors and sensors for kids to build creations and code them to move and react to their environment. Using a visual-based coding app, kids program a sequence of events and build a structure that carries out the code. WeDo 2.0 comes with several sensors that react to movement as well as a motor and power hub.



PRODUCT SPECIFICS

LEGO® WeDo 2.0 kits include:

- **LEGO® bricks**
- **Organizing tray**
- **Motors and sensors**

MENTOR NOTES

LEGO® WeDo 2.0 requires the use of an app to program and use the motors and sensors. This app is available for multiple devices and operating systems. The LEGO® Education website has links to download the app for each platform.

LEGO® WeDo 2.0 requires two AA batteries per kit.

ONLINE RESOURCES

- **https://education.lego.com/en-us/support/wedo-2**
  Overview of LEGO® WeDo 2.0 resources including lesson plans, teachers guide, and building instructions

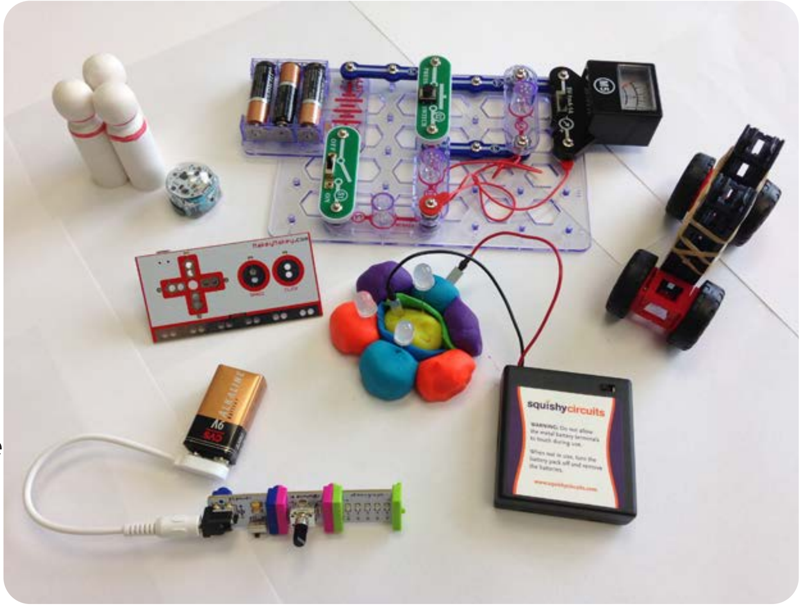
- **https://education.lego.com/en-us/lessons**
  LEGO® Education lesson plans

- **https://education.lego.com/en-us/downloads/wedo-2/software**
  LEGO® WeDo 2.0 App Downloads – available for multiple devices including tablets and computers

- **https://education.lego.com/en-us/support/3rd-party-support**
  Third-Party Software that is compatible with LEGO® WeDo 2.0

LESSONS

LESSONS



We put together several lessons that utilize the Ripken Foundation STEM Kit. The lessons will rely heavily on the equipment provided, but may call for some additional resources. These lessons are designed for primary or intermediate elementary and middle school range.

All of our lessons were developed to align with the Next Generation Science Standards. The Next Generation Science Standards is a national set of educational standards for STEM fields. These standards are used with in-school plans of study creating a cohesive learning experience for kids during mentoring programs. The Next Generation Science Standards were developed to establish skills and concepts crucial to STEM learning. By basing our curriculum on these standards, we are making sure that the activities and lessons create a meaningful experience for all children that attend Ripken Foundation STEM Center programs. This also places your organization ahead of others who do not align their programs to national standards, showing your dedication to education and youth development. For more information, visit **https://www.nextgenscience.org/**

BEE-BOT

OVERALL TIME *60-minute lesson*

GROUPS *Three to four kids per Bee-Bot*

Next Generation Science Standards: K-2 Engineering Design

ESS3-3
Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

Science and Engineering Practices
Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas.

OBJECTIVE

Kids will work together to program a Bee-Bot to meet different challenges.

OVERVIEW

Bee-Bots can be used to teach early programming skills, such as directionality, planning, sequencing, and counting while aligning to the engineering design process of working together. The Bee-Bot can travel forward, backward, as well as turn left and right.

MATERIALS

- **Bee-Bots (one per group of 3 to 4)**
- **Mats (alphabet, coins, city)**

PREPARATION

Clear a space for groups to be able to spread out and use a Bee-Bot. In this activity, kids will be provided with enough programming basics to get them started while allowing time for them to engage in free exploration.

LAUNCH *10 to 15 minutes*

Bring everyone together in a large circle. Make sure there is enough space for kids to move around. Tell the group that you will be giving a direction, and they need to move like a robot in that direction. For example, if the path is forward three steps, kids will move forward three steps like a robot. Have kids move, forward, backward, turn left, turn right, and complete a circle. Be sure to include the number of steps for each move, e.g. "move forward one step, turn right, or move forward three steps."

EXPLORATION *45 to 50 minutes*

Inform the group that they have just followed a sequence of code just like robots! Code is a set of instructions that tells a robot what to do.

Now, they are going to use what they learned about coding in this next activity. Choose one of the following mats to use for the lesson:

- Community Map
- US Coins
- Alphabet

Show the mat to the group highlighting the layout and the different items in the spaces on the mat. Depending on the mat, the groups will program their Bee-Bot to travel to/from a pre-selected starting and ending point. For example, if you are using the community mat, pick one of the stores that the Bee-Bot will leave from and pick a second store as the destination. The groups need to develop a sequence of instructions for the Bee-Bot to follow to get from the start to the end destination.

Tell the groups to write down what they think they need to input into the Bee-Bot. Have the groups come up with their sequence, input it into the Bee-Bot, and test it on the mat. After testing, encourage groups to go back and look at their instructions and see what needs to be modified. Allow groups to test and modify as time allows.

If all groups accomplish this route, select two different points with a slightly more complicated path. Other options for extending the lesson:

- If using the US Coins mat, select a monetary value (that is attainable by combining two or three of the coins on the mat). Have the groups find the coins that add together to that value, and program the Bee-Bot to start at one corner of the mat, and travel to pick up the coins.
- If using the Alphabet mat, select a two or three letter word. Have the groups program the Bee-Bot to spell the word starting from one corner of the mat and traveling to each letter in the word.

CLOSING *5 to 10 minutes*

With 5 to 10 minutes left in the session, bring everyone back together to discuss the activity. Ask the group the following questions, and have the kids respond:

- *Can you think of other things that might follow code like Bee-Bot?*
- *Did anything happen that you didn't expect?*
- *What did your group do well?*
- *What would you do differently next time?*

ENRICHMENT AND NEXT STEPS

Here are some ways to use Bee-Bot in future activities:

- Program a Bee-Bot to stop at all the vowels, silver coins, or letters that are the same color.
- Have the Bee-Bot travel the community pausing at each stop.
- Program the Bee-Bot to travel backward around the perimeter of the carpet or mat.
- Design a maze for the Bee-Bot using rulers, markers, books, or any additional materials.

BEE-BOTS DIORAMA STORYBOARD

OVERALL TIME *60-minute lesson*

GROUPS *One to two kids per group*

Next Generation Science Standards: K-2 Science and Engineering Practices

Developing and Using Models

Modeling in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solution

ETS1-2

Develop a simple model based on evidence to represent a proposed object or tool.

OBJECTIVE

Kids will work together using a grid to create a pathway for a Bee-Bot to travel.
Kids will sketch and communicate the programming code using directional vocabulary.

MATERIALS

- **Bee-Bots**
- **Bee-Bot Journal Page (one per group)**
- **Bee-Bot cutout (one per group)**
- **Scissors**
- **Pencil**
- **Colored pencils (optional)**

PREPARATION

Kids will use previous programming basics to create a code sequence. Prepare an example of a coding sequence on large paper mirroring the Bee-Bot Coding Journal to use in the launch. One example: forward, turn right, forward, forward. Decide if you want to assign partners ahead of time, or allow kids to pick their partner. Set up an area where groups can complete a test run using a Bee-Bot and grid mat.

KEY TERMS

Program: the action of writing code for computers

LAUNCH *10 to 15 minutes*

Bring everyone together in a large circle. Remind the group that they have been learning about coding using directions such as forward, backward, turn left, and turn right to program the Bee-Bots. Hold up and show off the example grid, then place it in the middle of the circle. Next, hold up the Bee-Bot. Tell the group that they are going to read the code on the Bee-Bot grid. Start by asking what the first move the Bee-Bot needs to make to follow the path. Choose someone to answer. Then, have them check their answer by using the example grid and program the Bee-Bot to go forward one move. Ask the kids if the move was correct. Ask them what move the Bee-Bot needs to make next. Continue until the example coding sequence is complete.

ACTIVITY *15 to 45 minutes*

Give each pair a Bee-Bot Coding Journal page and a Bee-Bot cutout. Tell everyone they will create a path for a paper bot to travel by coloring in a path of squares on their Bee-Bot Coding Journal page. The path should have the Bee-Bot make five or more moves, and include one start square and one stop square. Once the pairs are done with their path, have them switch worksheets with another group.

Once they have switched worksheets, have pairs use the Bee-Bot cutout to figure out the directions needed to navigate the path. Instruct the group to write their code on the bottom of the Bee-Bot Coding Journal page.

After testing on paper, have kids move to the grid mat and test their code with a Bee-Bot.

CLOSING *5 to 10 minutes*

Bring the group back together.

Ask the group the following questions and choose a few kids to respond.

- *How did you work together?*
- *How did you decide on the pattern the Bee-Bot would travel?*
- *Was it hard to identify the directions the Bee-Bot needed to take? Is so, what did you do?*
- *Did you use directional vocabulary while working with your partner?*

ENRICHMENT AND NEXT STEPS

Challenge kids to complete a Bee-Bot Coding Journal independently, and find the total distance in inches a Bee-Bot would travel, remembering the bot travels in six inch steps.

BEE-BOT CODING JOURNAL

NAME ______________________________

Write the code.
















CODE HOPPER

OVERALL TIME *60- to 70-minute lesson*

GROUPS *Three to four kids*

OBJECTIVE

Kids will work together to design a code sequence using two-sided mats.

OVERVIEW

Code Hopper is a fun way to introduce kids to computer programming through repeated body movements and actions, simulating how a computer follows commands.

VARIATION

This lesson could be completed over two days, demonstrating the launch on day one, followed by the activity on day two.

MATERIALS

- **Code Hopper (one per group)**
- **Color cards (optional)**

KEY TERM

Code: a list of instructions that a particular program operates by.

PREPARATION

Set up a large area for kids to be able to move around.

LAUNCH *10 to 15 minutes*

MOVING MATS

Have kids form a circle. Ask the group to raise their hand if they have played hopscotch. Tell kids that today they are going to be playing a coding hopscotch game.
Next, show the group the "start" mat and place it in the center of the circle. Then, choose a different piece. Look at the visual and read the action with the group. Together, complete the move, for example: stomp your feet. Attach this mat to the start mat. Continue this process until each of the pieces are used to complete the hopscotch. Then, finish by connecting the "stop" mat.

Have each kid take a turn playing hopscotch. Tell the group that in the next activity, they will be creating a Code Hopper hopscotch.

PREPARATION

Prepare a list of teams or give each kid a color card. The color represents the team they are on. Make space for each group to assemble the Code Hopper and number each station. Have a Code Hopper set ready for each team at each station. Decide on a signal to be used during rotations, for example: ring a bell or clap a pattern.

ACTIVITY - HOPSCOTCH *30 to 45 minutes*

In the launch, kids learned that each visual on a mat represents a movement. Have groups go to their assigned station. Review the signal and rotation pattern.

Have each participant take one of the mat pieces. Tell kids to decide which side of the mat they want to have as part of the coding sequence.

Each kid will attach a mat piece. After all of the pieces have been connected, kids can get in line and play hopscotch.

After 8 to 10 minutes, use the signal and have teams switch to a different hopscotch mat. Continue the rotation until every group has interacted with each hopscotch.

CLOSING *5 to 10 minutes*

Bring the group back together. Have each group collect the Code Hopper and replace the pieces in the container. Then, ask the following questions:

- *How did your team work together?*
- *Were there some similarities and differences between the different hopscotches?*
- *What is something that you want to try next time?*
- *Raise your hand if you had FUN!*

ENRICHMENT

Use sidewalk chalk and create a hopscotch game outside.

OVERALL TIME *60- to 90-minute lesson*

GROUPS *Three kids per kit*

Next Generation Science Standards
4PS3 Energy
4PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. An example of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound.

OBJECTIVE

Kids will apply the Engineering Design Process to build a moving object.

OVERVIEW

Kids should have had prior opportunities to explore with circuits using the introductory lessons included in the littleBits Educator's Guide. The group will engage in the engineering process to guide them as they brainstorm ideas, plan, test, modify, and retest their design to meet the challenge.

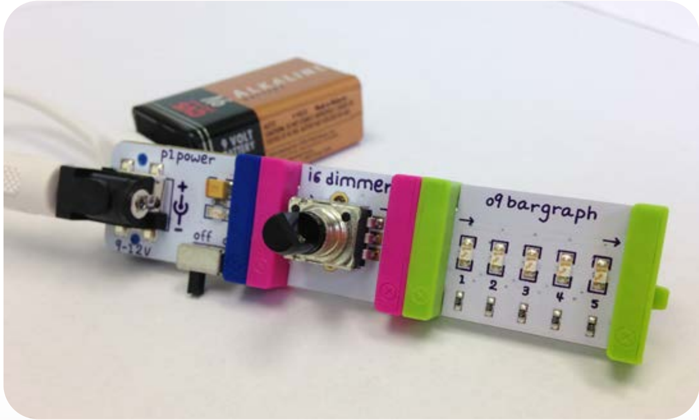
MATERIALS

- **littleBits kit**
- **Timer**
- **Paper**
- **Markers**
- **Tape**

PREPARATION

Each group will need an Engineering Design Process Sheet. Set up an area where kids can test and demonstrate their design. Provide each team with a piece of tape labeled with the group name or number. Post the different job roles, located in the launch on chart paper, or have it printed on index cards so each person in the group can take one.

*Kids will only be able to use the materials from the littleBits kit for the challenge.



LAUNCH *10 to 15 minutes*

Have kids form groups of three. Give each group a different colored marker and a sheet of paper. Tell the groups that they will be given five minutes to come up with a list of different types of items they use or have seen that include a switch, buzzer, or button circuit. Time the kids for five minutes. Set the timer and once the time is completed, have teams share their responses. Ask kids the following question:

How many of these items do you use or see daily? Have kids raise hands and share answers with the group.

Some possible answers:
Switch - lights, power windows, door locks on a car, radio, computer
Button - emergency stop buttons, phones, doorbells
Buzzer - horn, intercom, emergency doors

Tell kids that they will be creating electrical circuits. Review the Engineering Design Process with the group and answer questions as needed. Each kid will have a job in the challenge. Share the list of job roles and tasks assigned to each one. Provide teams with two minutes to decide on the different job roles.

Organizer - holds all kids accountable while supporting the work of the Programmer and Reporter, and keeps track of time.
Programmer - completes the working demonstration and is in charge of making modifications.
Reporter - sketches design, takes notes on experiments, and reports conclusions.

Share the challenge with mentees. The **challenge** is to create a design that moves and includes one of the following: switch, button, or buzzer.

EXPLORATION *50 to 60 minutes*

Teams will be given 25 minutes to design and build. Walk around to each group.

Possible questions to ask the **Organizer**:

- *What are your ideas for the design?*
- *What bits are you going to include?*
- *How did you decide?*
- *Did everyone contribute?*

After 25 minutes have gone by, give teams a 5-minute warning, marking 30 minutes. Check in with teams to see how much more time they will need. Feel free to allow more time if it is possible.

MODIFY *10 to 15 minutes*

Teams can take this opportunity to make modifications to their design, and then test again.

CLOSING: FINAL DEMONSTRATION

10 to 15 minutes

Choose a team to go first. Have the **Programmer** from the team come up and share their design and the different Bits used.

Next, call on the **Reporter** from each team to answer the following questions. If they need help, they can call on someone from their team to respond. *A variation could be to have each kid answer the following questions on an exit slip.*

Did your team have difficulty including any of the Bits?
What modifications did your team make along the way?
What could your design be used to do?
If you could go back, what would you do differently now?

Continue until all teams have had the opportunity to share.
* Encourage groups to cheer for each other, and take time for teams to thank each other for being a part of their learning community.

CLEAN-UP *5 minutes*

Have kids break apart the structures and use the littleBits Educator's Guide to put all the materials back in the box.

MAKEY MAKEY MUSIC AND FUN!

OVERALL TIME *60- to 75-minute lesson*

GROUPS *Three to four kids per kit and computer*

Next Generation Science Standards
Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
(3-5-ETS1-3)

OBJECTIVE

Design a musical device or game controller using Makey Makey.

OVERVIEW

Makey Makey is a computer chip that connects objects to a computer, changing those objects into a musical device or a game controller. Kids will use their knowledge of basic circuitry as they create their own design.

MATERIALS

- **STEM Lab Computers – connected to the internet**
- **Makey Makey kit & How To Use It sheet**
- **Music and Fun Challenge Sheet**
- **Additional Materials: bananas, oranges, celery, lemons, cardboard, paper, aluminum foil, Playdoh**

PREPARATION

Gather as many of the additional materials ahead of time.

LAUNCH *5 to 10 minutes*

Have kids form a circle. As a group, ask the kids to raise their hand and name different musical instruments. As the instruments are named, have the kids make the sound that instrument makes. You can also record the responses on a whiteboard.

If the group is having difficulty coming up with instruments, suggest a few and ask the group if they know what sound the instrument makes. Once you cover a few different types of instruments, shift the discussion and ask if they can name any video games or consoles that use a controller. Some examples are Xbox, PlayStation, Wii, Nintendo, Mario Kart, Minecraft, etc.

EXPLORATION *35 to 40 minutes*

During the previous activity, kids had the chance to share different musical instruments and gaming systems, now they can transfer those ideas into a Makey Makey design challenge. Task the teams to design a musical device or game controller.

Challenge: Try to include one or more of the additional materials as part of the design.

Review the materials that come in the kit: Makey Makey board, alligator cables, white wires, and USB cord, How-to Use It guide, and additional resources.

CLOSING *10 to 15 minutes*

Invite two teams to partner up and share their designs with each other. Here are some possible questions they can address while sharing:

- *What is your Makey Makey design?*
- *What worked well with this activity?*
- *Were there any challenges your team faced with this activity?*
- *How did your team address these challenges?*
- *What would you change, modify, or add to the design?*

Take time for teams to thank each other for being a part of their learning community.

ENRICHMENT AND NEXT STEPS

Have the kids create their own game or instrument simulator using scratch, then create the controller or instrument using Makey Makey.

Your team needs to create a musical instrument or game controller using the Makey Makey! Use the "How-to Guide" included with your Makey Makey to learn how the chip works, then let your imagination run wild! You will find some games and online instruments to play using the links below, but you must design and create a controller or instrument to make the online programs work!

As a bonus: use at least one of the additional materials available to make your game controller or instrument.

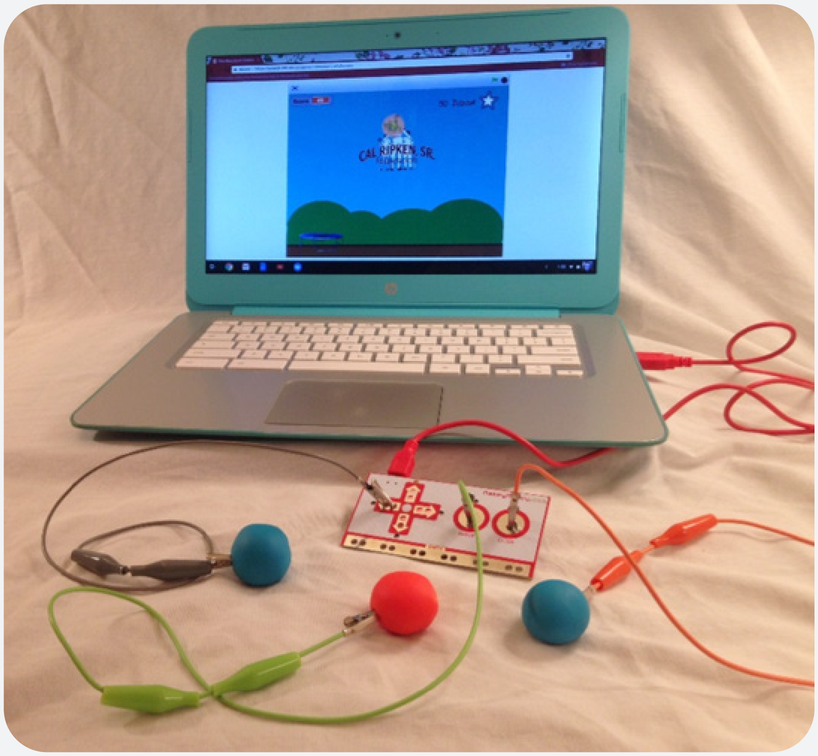
When time is up, share your design with another team and learn how to use their design!

ONLINE GAMES AND WEBSITES THAT WORK WITH MAKEY MAKEY:

- **https://scratch.mit.edu/users/CRSFSTEM/**
- **http://makeymakey.com/how-to/classic/**
- **http://makeymakey.com/apps/**
- **https://www.coolmath-games.com/0-jumpingarrows**
- **http://www.Guitarflash.com**
  - *On the game, you will have to change the "settings keys."*
  - *You can use the arrows and space, or use the back of the Makey Makey and use the "asdfg" keys.*

FOR AN EXTRA CHALLENGE

Use Scratch to create a program – either an instrument simulator or a game of your own – then create a controller with Makey Makey.



MAKEY MAKEY INTRODUCTION LESSON K-2
BASIC CIRCUITRY

OVERALL TIME *50- to 60-minute lesson*

GROUPS *Three to five kids per computer*

Next Generation Science Standards
Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
(K-2 ETS1-1)

OBJECTIVE

Kids will explore and interact with basic circuitry using Makey Makey.

MATERIALS

- **STEM Lab Computers**
- **Makey Makey kit**
- **Games/activities from the Makey Makey or Scratch websites**

PREPARATION

Set up two demo games or activities for six to eight stations from the Makey Makey or Scratch websites. Select two activities that integrate with your grade level standards in science, literacy, or math or one that you think would be engaging for the kids. For example, the bongo drums or banana keyboard for reinforcing different types of patterns, ABB, AABB, etc.

LAUNCH *10 to 15 minutes*

Explain to the group that they will explore and interact with basic circuitry using Makey Makey. Say which activities you selected. Then, choose two or three volunteers to come up in front of the class and demonstrate the activity.

EXPLORATION *35 to 40 minutes*

Have kids partner up in groups of four to five. Depending on the grade-level and time available, consider having the groups already formed and pre-select the order the kids will rotate.

Assign half of the group to one game station and the other half to the other station. Set a timer for 20 to 25 minutes to mark the time for kids to switch stations.

CLOSING *10 to 15 minutes*

Invite groups to gather around in a circle to answer the following questions:

- *What did you learn about Makey Makey?*
- *Which activity was your favorite? Why?*
- *Did you have fun?*
- *Are you interested in finding out more about Makey Makey?*

MAKEY-MAKEY K-2 BLOCK CODING

OVERALL TIME *One or two 50- to 60-minute lesson(s)*

GROUPS *Three to five kids per computer. Depending on the grade level and time available, consider having the groups already formed.*

Next Generation Science Standards

Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

(K-2 ETS1-1)

OBJECTIVE

Kids will explore programming using block coding.

MATERIALS

- **STEM Lab Computers**
- **Coding Journal**
- **Scratch website tutorials https://scratch.mit.edu/educators**

Optional:

- **Scratch Coding Cards (downloadable from website)**
- **Scratch Jr. and iPads (if available)**

KEY TERMS

Algorithm: a list of steps to complete a task

Program: an algorithm that contains a series of coded instructions to be followed by a computer or other machine

Programming: designing and creating a program

PREPARATION

Take some time to view the tutorials on the website. Then, choose a tutorial for the kids to view. Connect a computer to a projector to display during the launch. Show the introduction video for the selected tutorial. Prior to the lesson, print a coding journal for each kid. Prepare the following T-Chart to utilize during the launch.

What do you know or think you know about coding?	What do you want to learn about coding?

LAUNCH *5 to 10 minutes*

Ask kids what they know or think they know about coding. Record responses on the left side of the T-Chart. Then, ask what they would like to learn about coding. Record responses on the right side.

EXPLORATION *35 to 40 minutes*

Review the school's technology expectations with the group. Explain they will be learning more about how to code using Scratch.

Display the preselected coding tutorial. Once done, have groups practice what they have learned on their computers. Have kids sketch or write what they learned in the Coding Journal.

Then, review another tutorial as a large group or have everyone choose one individually. Once done, have them record what they learned in the journal.

CLOSING *10 to 15 minutes*

Have the group clean up and form a large circle. Here are some possible discussion starters:

- *Share one thing learned about coding.*
- *Were there any parts of coding that were challenging?*
- *What would you like to try next?*

ENRICHMENT AND NEXT STEPS

Kids can continue with the Scratch tutorials or use other programming apps such as Hour of Code and Kodable.

Print out extra sets of Scratch task cards for students to take home.

MAKEY MAKEY INTRODUCTION LESSON 3-5
BASIC CIRCUITRY

OVERALL TIME *50- to 60-minute lesson*

GROUPS *Three to five kids per computer*

Next Generation Science Standards

Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

(K-2 ETS1-1)

OBJECTIVE

Kids will explore and interact with basic circuitry using Makey Makey.

MATERIALS

- **STEM Lab Computers**
- **Makey Makey kit**
- **Games/activities from Makey Makey or Scratch websites**
  - **https://scratch.mit.edu**
  - **https://makeymakey.com**

PREPARATION

Set up two demo games or activities for six to eight stations from the Makey Makey or Scratch websites. Select two activities that integrate with your grade level standards in science, literacy, or math or one that you think would be engaging for your group. For example, the bongo drums or banana keyboard for reinforcing different types of patterns, ABB, AABB, etc.

LAUNCH *10 to 15 minutes*

Explain to the group that they will explore and interact with basic circuitry using Makey Makey.

Show the group the materials that come in the kit:

- Makey Makey board
- Alligator cables
- White wires
- USB cord
- How To Use It guide

Explain how these materials are used in the selected activities.

Next, share the activities you selected. Then, choose two or three volunteers to come up in front of the class to demonstrate each activity.

EXPLORATION *40 to 50 minutes*

Have kids form groups of four to five. Depending on the grade level and time available, consider having the groups already formed.

Explain to the group that they will have time to explore the Makey Makey and Scratch websites. Each group will choose an activity or game to try out. The challenge is for groups to find an activity that uses up to four arrows on the keyboard or the Makey Makey board.

**Remind kids of your school's technology expectations.*

CLOSING *10 to 15 minutes*

Invite teams to gather around in a circle to answer the following questions:

- *What activity did your group try?*
- *Did you use the keyboard arrows or the Makey Makey board?*
- *What did you learn about Makey Makey?*
- *Are you interested in finding out more about Makey Makey?*
- *What would you like to try next using Makey Makey?*

NOTE

If more time is needed, consider having an additional exploration day.

MAKEY MAKEY 3-5 BLOCK CODING

OVERALL TIME *One or two 50- to 60-minute lesson(s)*

GROUPS *Four to five kids per computer. Depending on the grade level and time available, consider having the groups already formed.*

Next Generation Science Standards

Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

(3-5 ETS1-1)

OBJECTIVE

Kids will explore programming using block coding to solve a problem or complete an action.

MATERIALS

- **STEM Lab Computers**
- **Coding Journal**
- **Scratch website: https://scratch.mit.edu/educators**

Optional:

- **Scratch Coding Cards (downloadable from website)**

KEY TERMS

Algorithm: a list of steps to complete a task

Program: an algorithm that contains a series of coded instructions to be followed by a computer or other machine

Programming: designing and creating a program

PREPARATION

Take some time to view the tutorials on the website. Then, choose a tutorial for the kids to view. Connect a computer to a projector during the launch. Show the introduction video for the selected tutorial. Prior to the lesson, print a coding journal for each person.

LAUNCH *5 to 10 minutes*

Provide each kid with a coding journal. Give them five minutes to respond to the following questions in their journal:

- *What is your experience with coding?*
- *What would you like to learn about coding?*

Next, have them partner up and share their responses with three other people. Have each person write down one thing their partners shared in the journal. Have music, a timer, or a bell to signal a partner change.

EXPLORATION *35 to 40 minutes*

Review the school's technology expectations with the group. Explain that they will be learning how to code using Scratch.

Introduce the group to the coding tutorials on the Scratch website using the one you have preselected. Provide each kid with a coding journal. Each person then chooses one tutorial to explore from each of the Scratch categories: animation, art, music, games, or stories.

Kids will not have time to view all tutorials during this lesson. In the journal, kids should write down what they learned from the tutorials they viewed. Additionally, they may note any categories they may want to revisit.

CLOSING *10 to 15 minutes*
Have everyone clean up and form a large circle for a coding debrief. Here are some possible discussion starters:

- *Share one thing you learned about coding.*
- *Were there any parts of coding you found challenging?*
- *What is one thing you would like to try?*

ENRICHMENT AND NEXT STEPS

Have kids continue with learning to code using the Scratch tutorials or other programming apps such as Hour of Code or Hopscotch.

Print out extra sets of Scratch task cards to take home.

Sketch or write about what you learned.

Rate how you feel about programming using an emoji.

MY CODING JOURNAL 3-5

Name ___________________ Date ____________________

CODING JOURNAL

What is your experience with coding?

What would you like to learn about coding?

Partner 1 ____

Partner 2 ____

Partner 3 ____

Name ___________________ Date ____________________

CODING JOURNAL

What is your experience with coding?

What would you like to learn about coding?

Partner 1 ____

Partner 2 ____

Partner 3 ____

Circle the category: animation music games stories

Sketch an example from the lesson.

When would you use this learning in a project?

Circle One

1. **I could use help with this.**
2. **I am starting to understand, but I could use more time and/or help.**
3. **I understand! I can do this on my own.**
4. **I am confident! I can help a friend.**

Circle the category: animation music games stories

Sketch an example from the lesson.

When would you use this learning in a project?

Circle One

1. **I could use help with this.**
2. **I am starting to understand, but I could use more time and/or help.**
3. **I understand! I can do this on my own.**
4. **I am confident! I can help a friend.**

OZOBOT BOWL-O-RAMA

OVERALL TIME *60-minute lesson*

GROUPS - *Activity 1: partners*
- *Activity 2: groups of three to four*

Next Generation Science Standards

Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

(3-5-ETS1)

OBJECTIVE

Demonstrate an understanding of programming basics using color-coding.

OVERVIEW

Kids will use programming basics to program a small robot to act as a bowling ball to push down pins.

MATERIALS

- Ozobots
- Markers
- Ruler
- Paper (plain)
- Bowling set
- Ozobot Bowling sheet (copies for every kid)
- OzoCodes sheet

KEY TERMS

Ozobot: A programmable robot that follows commands from color-coded paths on paper, as well as computer coding.

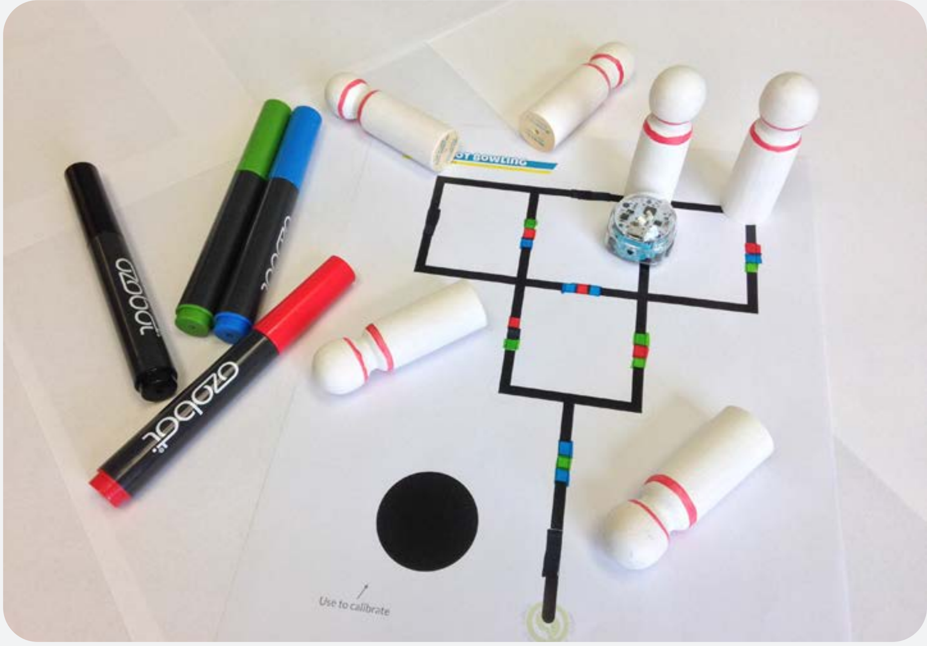
Coding: A set of signals called code are sent to a device to provide specific instructions on how to perform an action. With Ozobot, the robot reads the code via colored dots on a piece of paper.

PREPARATION

- Prepare a couple examples of solid lines using the Ozobot colored markers along with an example of a rectangle or other shapes.

- Complete a color-coded Ozobot bowling sheet ahead of time to use for the activity demonstration.

- Make copies of Ozobot bowling sheet (1 per child) and Ozobot Score sheet (1 per group of 3 to 4 kids)



LAUNCH *10 to 15 minutes*

Have kids gather around in a circle. Model programming techniques for the Ozobot using the sheets prepared ahead of time (line and shapes). Make sure to reference how the width of a line and line spacing helps the Ozobot to read the program.

Activity 1 - Color Coding

Have kids partner up to explore creating color-coded programming for the bot with lines and shapes. Kids will need a blank piece of paper and markers for this activity.

Bring the group back together and collect Ozobots. Choose a few kids to share their observations.

The Ozobot bowling sheet is in the resources included with the classroom kit. The OzoCodes sheets are also in the classroom kit. Both can also be downloaded online from:
http://ozobot.com/stem-education/stem-classroom-kit

EXPLORATION *40 to 45 minutes*

Activity 2 - Ozobot 10 Pin Bowling

Kids are going to take their learning from the color coding activity and apply it to a bowling challenge. They will use color-coding to program the Ozobot to act as a bowling ball to push down pins.

Display an example of a color-coded Ozobot Bowling sheet. Show kids the OzoCode sheet and how it is used to create patterns for speed and turns of the Ozobot. Set up the 10 bowling pins on the bowling sheet. Turn on the Ozobot and let it read the programming. Count how many pins are pushed over, for example, if seven pins are pushed or knocked over, your score would be seven for that round. Write down the score on the score sheet and any additional observations (i.e. if the 2, 3, and 5 pin are left standing up, write it down).

Each child will design an individual Bowling Sheet using the Ozobot Coding Sheet. Provide kids with adequate time to complete an individual color-coded bowling sheet.

When kids finish color-coding, they can make groups of 3 to 4 to start bowling using the Ozobot. Each child will use their individual programming sheet to bowl. Have teams play as many rounds as time permits. The player with the most points at the end is the winner. Teams can keep score on the bowling sheet and make notes under observations of what pins remained standing. The notes can be used later to make changes and programming adjustments.

Clean up materials. Take time for teams to thank each other for being a part of their learning community.

CLOSING *5 minutes*

Have each team respond to the following questions:

- *What did you learn about programming the Ozobot from this activity?*

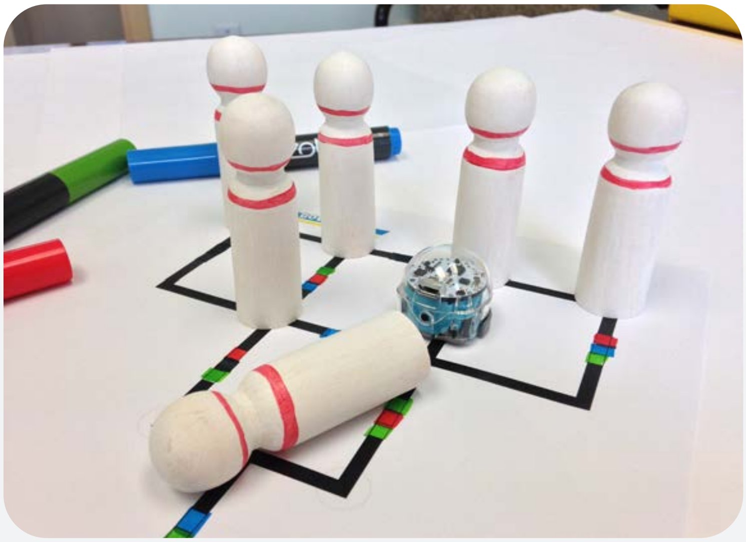
- *Was there a color-coding pattern that worked better? Why?*

- *If you had an opportunity to make changes, what would you make, why?*

Choose a couple of teams to share their responses with the larger group.

ENRICHMENT AND NEXT STEPS

Have the kids design a maze that their peers will have to fill in with OzoCode to get to the end.



OVERALL TIME *60- to 75-minute lesson*

GROUPS *Three to four kids per kit*

Next Generation Science Standards
(4th grade and up)
Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
(3-5-ETS1-3)

OBJECTIVE

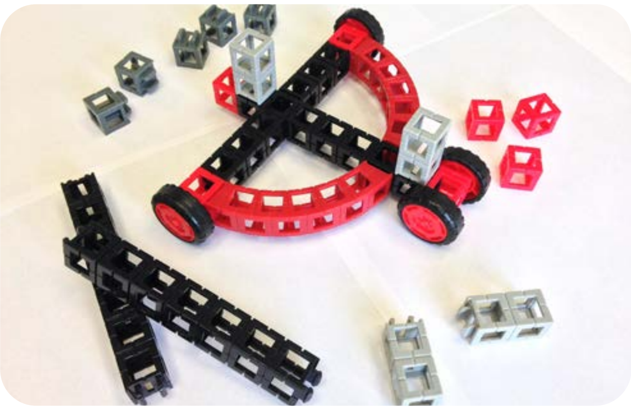
Kids will apply the Engineering Design Process to solve a problem.

OVERVIEW

Kids will have the opportunity to work together as a team to solve a problem using the Engineering Design Process. The team will use the engineering design process to guide them as they brainstorm ideas, plan, test, modify, and retest their design. Add collected measurement data to the class chart to see which team's vehicle traveled the farthest.

MATERIALS

- ROK Block kit
- Ramp (optional)
- Tape Measure
- Paper
- Pencils
- Masking Tape
- Chart Paper



PREPARATION

- Create a class team chart with a row for each team, and a column to record the distance their vehicle traveled

- Set up an area where kids can complete a test run

- One piece of tape per team labeled with the team's name or number

LAUNCH *5 to 10 minutes*

Introduce the Engineering Design Process with the group. Each child will have a job in the challenge. Share the list of job roles and tasks assigned to each child. Provide teams with two minutes to decide on the different job roles.

Organizer: helps decide roles, holds all kids accountable, and keeps track of time.

Technician: measures, sketches, and makes sure data is recorded.

Programmer: completes tests and the final run; and is in charge of making modifications.

Reporter: takes notes on experiments and reports conclusions.

CHALLENGE

Introduce the challenge to the teams:
The objective of this challenge is to have a vehicle that can travel the farthest distance going down a ramp carrying a load of 12 balls (6 red and 6 blue) from the kit. All balls must remain inside of the vehicle while traveling down the ramp. The vehicle that goes the farthest will win the challenge.

EXPLORATION *45 to 50 minutes*

Give teams 30 minutes to design and build a vehicle. Walk around to each group as they are designing and talk with the youth.

Possible questions to ask:

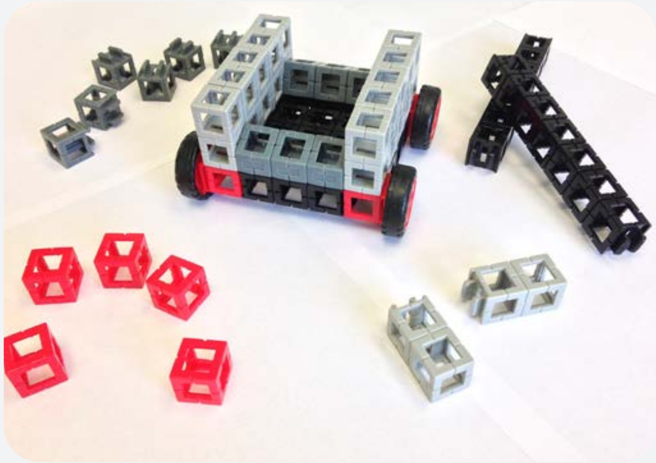
- *What are your ideas for the design?*

- *How did you decide?*

- *Did everyone contribute?*

Give time warnings along the way to keep teams on track. Suggested times: halfway, 10 minutes left, five minutes left, one minute left

Encourage groups to test and modify their design as they go and allow them to use the ramp to practice.



OFFICIAL RUNS *10 minutes*

The ramp should be viewable by all kids. Choose a team to go first and have the Programmer from each team come up to complete the official run for the vehicle. As each vehicle goes down the ramp, have a piece of masking tape ready with the team number and place it where the vehicle stopped. Then, have the Technician measure the distance the vehicle traveled and record data on the class chart. Continue until all teams have had the opportunity to test their vehicle.

**Encourage teams to cheer each other on.*

CLOSING *5 to 10 minutes*

Call on the Reporter from each team to answer the following questions. If they need help, they can call on someone from their team to answer. A variation could be to have each child answer the following questions on an exit slip.

- *How did your design work?*

- *Did your team test the design before the official run?*

- *What changes did you make after the test run?*

- *If you could go back, what would you do differently now?*

- *How did each of your teammates work together?*

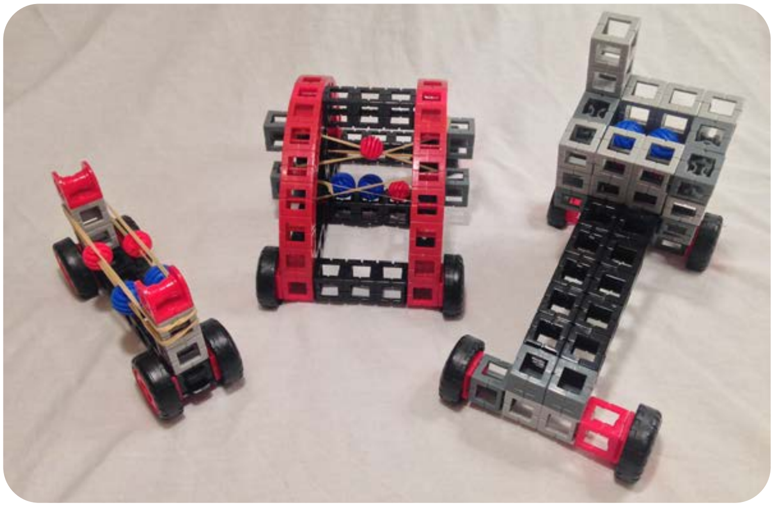
Take time for teams to thank each other for being a part of their learning community.

CLEAN UP *5 minutes*

Have children break apart vehicles and use the ROK Blocks guide to put all the materials back in the box.

ENRICHMENT AND NEXT STEPS

Change the challenge and have teams design vehicles to meet a new standard – which can travel the furthest, carry the heaviest load the furthest, or a vehicle only using two wheels – the possibilities are endless!



OVERALL TIME *60- to 90-minute lesson*

GROUPS *Three to four kids per kit.*

Next Generation Science Standards
(4th grade and up)
Plan and carry out fair tests in which variables are controlled, and failure points are considered to identify aspects of a model or prototype that can be improved.
(3-5-ETS1-3)

OBJECTIVE

Kids will apply the Engineering Design Process to solve a problem.

OVERVIEW

Kids will have the opportunity to work together as a team to solve a problem using the Engineering Design process. The team will engage in the engineering process to guide them as they brainstorm ideas, plan, test, modify, and retest their design. Teams will record data to see which team's structure can hold twelve thin books.

MATERIALS

- ROK Blocks Kit
- Timer
- Chart Paper
- Markers
- Tape
- Rulers
- 12 thin books

Variation: use a different amount of books or other objects as weights

PREPARATION

- Set up an area where mentees can complete the weight test. Create a Class Data Chart with the headings, "Team," "Height," and "Books." Write down the job roles with task assignments and the challenge on chart paper. Have one Engineering Design Process sheet and a piece of tape per team labeled with the team's name or number.

* Kids will only be able to use the materials from the ROK Blocks kit for the challenge.

LAUNCH *10 to 15 minutes*

Review the Engineering Design Process and the challenge with the group. Each kid will have a job in the challenge. Share the list of job roles and tasks assigned to each one. Provide teams with two minutes to decide on the different job roles.

Organizer: helps decide roles, holds all kids accountable, and keeps track of time.

Technician: measures, sketches, and records data.

Programmer: completes the test, final demonstration, and is in charge of making modifications.

Reporter: takes notes on Engineering Design Process sheet and reports conclusions.

ACTIVITY

A new office building needs to be constructed. The company is requesting the tallest structure possible to allow for maximum office space. However, with the harsh winters in this region, the design needs to support the extra weight of snow and ice during the winter months.

Design the tallest standing structure using ROK Blocks that can support the weight of twelve thin books representing snow and ice.

EXPLORATION *45 to 60 minutes*

Teams will be given 25 minutes to design and build the tallest structure. Walk around to each group.

Possible questions to ask:

- *What are your ideas for the design?*
- *How did you decide?*
- *Did everyone contribute?*

After 20 minutes have gone by, give teams a five-minute warning.

Test *(5 to 10 minutes)*

Have teams test their structures as they are ready.

Modify *(10 to 15 minutes)*

Kids can take this opportunity to make modifications to their structure.

Final demonstration *(10 to 15 minutes)*

Choose a team to go first. The **Organizer** will keep track of time. Each team will have two to three minutes to perform the demonstration. Have the **Programmer** from the team come up to complete the test. Then, have the **Technician** record the team number, and the number of books the structure can hold on the class chart. Continue until all teams have had the opportunity to complete the weight test.

**Encourage teams to cheer each other on.*

CLOSING *10 to 15 minutes*

Call on the **Reporter** from each team to answer the following questions. If they need help, they can call on someone from their team to respond. *A variation could be to have each kid answer the following questions on an exit slip.*

- *What changes did you make after the practice test?*
- *Why do you think your design met or didn't meet the challenge?*
- *If you could go back, what would you do differently now?*
- *How did each of your teammates work together?*

Take time for teams to thank each other for being a part of their learning community.

CLEAN-UP *5 minutes*

Have groups break apart the structures and use the ROK Blocks guide to put all the materials back in the box.

NEXT STEPS OR TAKE HOME CHALLENGE

Allow kids to complete a similar challenge by exploring other materials, such as blocks, paper, or cards, to build a tall structure. Weights could be dice or pencils. Be creative!

SNAP CIRCUITS ELECTRIC BINGO

OVERALL TIME *60-minute lesson*

GROUPS *Three to four kids per kit*

Next Generation Science Standards
Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound.)
(Energy 4PS3-4)

OBJECTIVE

- **Identify and construct different types of circuits.**
- **Make connections to energy sources in real life.**

OVERVIEW

Kids will engage in the basics of circuitry by building and drawing working electronic circuits.

MATERIALS

- **Snap Circuit Kit & Resource Book**
- **STEM Circuit BINGO Board**
- **Pencils/Writing Utensils**
- **Batteries (AA)**

KEY TERMS

Circuit: a complete and closed path around which electricity can flow.

Closed Circuit: an endless path for electricity to flow.

Conductor: an object or material that allows the flow of electrical current in one or more directions.

Insulator: an object or material that allows little or no electricity to go through.

Negative: the negative pole of a storage battery.

Open Circuit: an electrical circuit that is not complete.

Parallel Circuit: a circuit which has two or more paths for electricity to flow.

Polarity: attraction toward a particular object or in a specific direction.

Positive: the positive pole of a storage battery.

Series Circuit: an electrical circuit in which electricity passes through components following one path.

Short Circuit: the failure of electricity to flow properly.

LAUNCH *5 to 10 minutes*

Have kids stand in a circle. Ask the following question and give kids a moment to think.

What items do you see every day that use energy from electrical current?

Go around the circle and have each child share an example, trying not to repeat one that was already said. This activity represents how much we rely on electricity throughout a given day.

EXPLORATION *40 to 50 minutes*

Provide each team with a STEM bingo board (see page 26). Using Snap Circuits, the team will need to work together to build various types of circuits working towards a blackout bingo board (all boxes filled in). Each box of the bingo board has a different type of circuit or Snap Circuits component the team must build or incorporate in the build. Once they have built the circuit, the group must write down an example of where they might see this in real-life. For example, the flying saucer is an example of a ceiling fan, whereas a light switch is an example of a circuit with a switch.

As kids are working, walk around to each of the groups.

Possible questions to ask:

- *What circuit are you building?*
- *What order are you connecting the parts?*
- *Can you trace the path the current flows through the circuit?*

CLOSING *5 to 10 minutes*

Allow kids time to clean up and organize the Snap Circuits.

Bring the group back together. Ask kids to find a partner and answer the following questions:

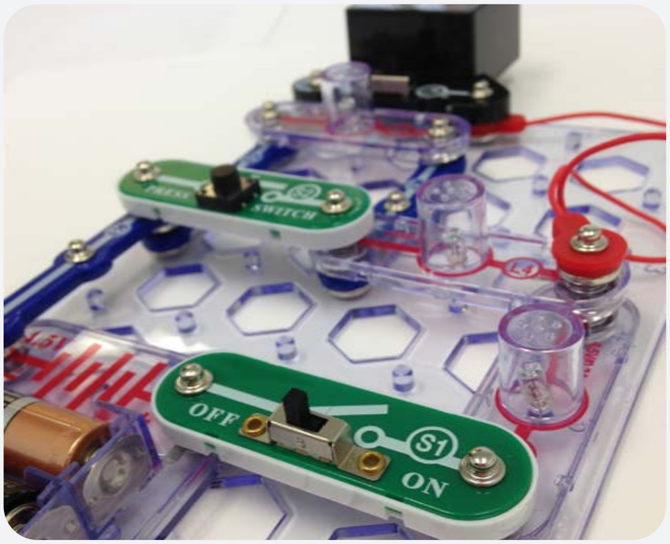
- *What new learnings did you have?*
- *What circuits were challenging to make?*
- *Why?*
- *Was your team able to make real life circuit connections?*

Choose a few partners to share aloud with the large group.

***Note:** *Have teams give each other a high five to celebrate their new learning.*

ENRICHMENT AND NEXT STEPS

Allow kids to explore the Snap Circuits guidebooks and build as many circuits as they want. Challenge them to design their own and explain how it works.



SNAP CIRCUITS BINGO

NAME ____

Using Snap Circuits, build an example of each of the circuits listed below. Then in the box, write down a short description, sketch of the activity, and where have you seen an example of this in real life?

COMPLETE CIRCUIT	FLYING SAUCER	MOTOR CIRCUIT
FAN	**FREE (YOUR CHOICE)**	**PARALLEL CIRCUIT**
SWITCH CIRCUIT	**SERIES CIRCUIT**	**SOUND**

OVERALL TIME *60- to 120-minute lesson*

GROUPS *Three to four kids per kit*

Next Generation Science Standards
4PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound.)
(4PS3 Energy)

OBJECTIVE

- **Identify and construct different types of circuits.**
- **Make connections to energy sources in real life.**

MATERIALS

- **Snap Circuit Kit (one per group)**
- **Snap Journal (one per person)**
- **Chart Paper**

PREPARATION

Copy Snap Journals for the class.
On chart paper, write the challenge and requirements.

LAUNCH *5 to 10 minutes*

Have kids form a circle. Ask them to think about what their life would be like without electricity. Are there things they would miss? Go around in a circle and have each kid name one thing.

EXPLORATION *40 to 90 minutes*

Have kids form groups of three to four. Once kids are in groups, explain that they will be exploring and interacting with basic circuitry using Snap Circuits to perform a challenge. Introduce the challenge, requirements, and Snap Journal.

CHALLENGE

Create a circuit that includes the following: light, movement, and sound.

Requirements:

- Groups will present their design.
- All kids will complete a Snap Journal.
- Each group member will be responsible for answering one or more of the following questions during the presentation:
  - *What is your Snap Circuit design?*
  - *Does your design include light, movement and sound?*
  - *Explain and demonstrate how the circuit works.*
  - *How did your team decide on this design?*
  - *Were there any challenges your team faced during this activity?*
  - *How did your team address these challenges?*

CLOSING *15 to 25 minutes*

Allow each team 3 to 5 minutes to present.

OVERALL TIME *60- to 120-minute lesson*

GROUPS *Three to four kids per kit*

Next Generation Science Standards
4PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound.)
(4PS3 Energy)

OBJECTIVE

- **Identify and construct different types of circuits.**
- **Make connections to energy sources in real life.**

MATERIALS

- **Snap Circuit Kit (one per group)**
- **Snap Journal (one per person)**
- **Chart Paper**
- **Vocabulary cards (one set for each group)**
- **Timer**

KEY TERMS

Circuit: a complete and closed path around which electricity can flow.

Closed Circuit: an endless path for electricity to flow.

Conductor: an object or material that allows the flow of electrical current in one or more directions.

Insulator: an object or material that allows little or no electricity to go through.

Negative: the negative pole of a storage battery.

Open Circuit: an electric circuit that is not complete.

Parallel Circuit: a circuit which has two or more paths for electricity to flow.

Polarity: attraction toward a particular object or in a specific direction.

Positive: the positive pole of a storage battery

Series Circuit: an electrical circuit in which electricity passes through components following one path.

Short Circuit: the failure of electricity to flow properly.

PREPARATION

Copy Snap Journals for the class. On chart paper, write the challenge and requirements. Have a copy of the vocabulary cards cut out for each group.

LAUNCH *10 to 15 minutes*

Have children form groups of 3 to 4. Explain to kids that they will be working together to complete an electricity vocabulary match. Pass out a set of cards to each group. Then, set a timer for five minutes. After kids have discussed and completed the match, ask if they have any questions about the vocabulary words.

EXPLORATION *45 to 90 minutes*

Have kids form groups of three to four. Once kids are in groups, explain that they will be exploring and interacting with basic circuitry using Snap Circuits. Introduce the challenge, requirements, and Snap Journal.

CHALLENGE

As a team, think of an improvement to the classroom that could be made with electricity. For example, adding a doorbell to the classroom. Kids will make a model of their circuit using Snap Circuits. Teams will be allowed to use the Electronic Snap Circuits Instruction Manual. However, if the team uses the diagram from the manual to create the circuit, an additional change or modification must be made.

Requirements:

- Groups will present their design.
- All kids will complete a Snap Journal.
- Each group member will be responsible for answering one or more of the following questions during the presentation:
  - *What is your new Snap Circuit design that improved your classroom?*
  - *Explain and demonstrate how the circuit works.*
  - *How did your team decide on this design?*
  - *If you used the manual diagram, what modification did your team make?*
  - *Were there any challenges your team faced with this activity?*
  - *How did your team address these challenges?*

CLOSING *15 to 25 minutes*

Allow each team 3 to 5 minutes to present.

ELECTRICAL VOCABULARY

Circuit	a complete and closed path around which electricity can flow	**Closed Circuit**	an endless path for electricity to flow
Short Circuit	the failure of electricity to flow properly	**Series Circuit**	an electrical circuit in which electricity passes through components following one path
Positive	the positive pole of a storage battery	**Conductor**	An object or material that allows the flow of electrical current in one or more directions
Insulator	an object or material that allows little or no electricity to go through	**Negative**	the negative pole of a storage battery
Open Circuit	an electric circuit that is not complete	**Parallel Circuit**	a circuit which has two or more paths for electricity to flow
Polarity	Attraction toward a particular object or in a specific direction		

OVERALL TIME *60- to 120-minute lesson*

GROUPS *Three to four kids per kit*

Next Generation Science Standards

4PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound.)

(4PS3 Energy)

OBJECTIVE

- **Identify and construct different types of circuits.**
- **Make connections to energy sources in real life.**

MATERIALS

- **Snap Circuit Kit (one per group)**
- **Snap Journal (one per person)**
- **Chart Paper**
- **Markers**
- **Masking Tape**

PREPARATION

Copy Snap Journals for the class. On chart paper, write the challenge and requirements.

LAUNCH *5 to 15 minutes*

Have kids form groups of three to four. Provide each group with a piece of chart paper and markers. Explain to kids that they will have ten minutes to create a list of as many electricity words as possible. When the ten minutes are up, have kids display their posters on the wall.

Then, have groups participate in a Gallery Walk to view all posters.

Choose a few kids to respond to the following questions:

- *Did you notice any words that appeared on every list?*
- *Is there a word that stuck out for you during the Gallery Walk? What word? Why?*

EXPLORATION *45 to 90 minutes*

Explain to kids that they will be exploring and interacting with basic circuitry to create a new circuit using Snap Circuits. Groups will remain the same for the challenge. Introduce the challenge, requirements, and Snap Journal.

CHALLENGE

Design your own Snap Circuit.

Requirements:

- Groups will present their design.
- All kids will complete a Snap Journal.
- Each group member will be responsible for answering one or more of the following questions during the presentation:
  - *What is your new Snap Circuit design that improved your classroom?*
  - *Explain and demonstrate how the circuit works.*
  - *How did your team decide on this design?*
  - *Were there any challenges your team faced with this activity?*
  - *How did your team address these challenges?*

CLOSING *15 to 30 minutes*

Allow each team 3 to 5 minutes to present.

OVERALL TIME *60-minute lesson*

GROUPS *Three to four kids per kit*

Next Generation Science Standards

Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

(Energy 4PS3-4)

OBJECTIVE

Kids will identify materials as conductors or insulators for electricity to travel.

OVERVIEW

Children will have the opportunity to build upon previous circuit learning while creating circuits using electrical and motion energy with conductor (Playdoh) and insulator (modeling clay) materials.

MATERIALS

- **Squishy Circuits**
- **Circuit Sketch Sheet**
- **Pencils (optional-colored pencils)**
- **Insulator and Conductor examples**
- **Batteries (AA)**

KEY TERMS

Circuit: a complete and closed path around which electricity can flow.

Closed Circuit: an endless path for electricity to flow.

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Polarity: attraction toward a particular object or in a specific direction.

Positive: the positive pole of a storage battery.

Series Circuit: an electrical circuit in which electricity passes through components following one path.

Short Circuit: the failure of electricity to flow properly.

PREPARATION

Gather some common everyday materials ahead of time:

Sample conductors: penny, aluminum foil, paperclip, water, (Playdoh will be the conductor in the experiment)

Sample insulators: rubber band or rubber ball, something plastic, glass, wood (baseball bat) (modeling clay will be the insulator in the experiment)

LAUNCH *15 to 20 minutes*

Activity 1-Circuit Model
Have kids form a circle by holding hands. This activity will model how electricity flows through a circuit. The leader starts by squeezing the hand of the person next to them. Kids will squeeze the hand of the person next to them and this pattern continues until it comes back to the leader. The leader can then ring a bell or raise their hand to represent a closed complete path. Next, have one kid step out of the circle to represent an open, not complete circuit. Ask kids, what just happened? What might the break in the chain represent?

Activity 2-Conductor or Insulator
The previous activity modeled how a complete circuit is made. Now, we are going to learn about different types of materials that allow electricity to flow in one or more directions called conductors. Other materials that allow little or no electricity to go through are called insulators.

Hold up the common everyday items (i.e. paperclip) one at a time. Ask the group: Does this paperclip act as a "conductor" or as an "insulator" for electricity? A follow up question could be, what makes you think that?

EXPLORATION *35 to 40 minutes*

Task the children to use Squishy Circuits and challenge them to do the following:

1.) Make a complete circuit with a light bulb.

2.) Make a circuit with a motor and switch.

3.) Choose a circuit to create.

Review the materials that come in the kit (battery holder, wires, motor, switch, Playdoh, modeling clay, LED lights). Hold up the LED light and show kids the longer terminal. This terminal will need to go in the dough with the positive (red) wire. Have kids sketch and label each of the circuits created using the Circuit Sketch sheet.

CLOSING *5 minutes*

Have youth partner up with someone from a different group to share new learning from their choice circuit.

ENRICHMENT AND NEXT STEPS

Have extra colored Playdoh out for children to design a creature or organism light up sculpture.

CIRCUIT SKETCHES

NAME ____

Design, sketch, and label the following circuits:

COMPLETE CIRCUIT

MOTOR AND SWITCH

CHOOSE YOUR OWN

LEGO® CODING EXPRESS

OVERALL TIME *60- to 90-minute lesson*

GROUPS *Three to four kids per Coding Express Kit*

Next Generation Science Standards: K-2 Engineering Design

Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

ETS1-1

· *Ask questions based on observations to find more information about the natural and/or designed world(s).*

· *Define a simple problem that can be solved through the development of a new or improved object or tool.*

ETS1-2

· *Develop a simple model based on evidence to represent a proposed object or tool.*

· *Asking questions, making observations, and gathering information are helpful in thinking about problems.*

· *Before beginning to design a solution, it is important to clearly understand the problem.*

OBJECTIVE

Kids will work together to create a city that includes all action bricks from the LEGO® Coding Express kit.

OVERVIEW

The LEGO® Coding Express kit includes cards and videos for introducing the materials. Kids then build upon those lessons while creating a city that offers a variety of goods and services.

MATERIALS

- **LEGO® Coding Express kit (one per group of three to four)**
- **Chart paper**
- **Markers**

PREPARATION

Clear a large space for groups to spread out and use the LEGO® Coding Express materials. Make a large circle map on chart paper with the word “city” in the middle.

LAUNCH *10 to 15 minutes*

Bring everyone together in a large circle. Tell kids that they are going to share what they know about cities. Cities can vary in size, but all cities usually include special attractions or businesses while providing many goods and services.

Have kids partner up and ask them to discuss what they might see in a city. Then, ask them to share their responses out loud. Record the responses on a piece of chart paper.

EXPLORATION *45 to 60 minutes*

Have kids get into groups of three or four. Instruct each group to build a city using LEGO® bricks that includes a variety of goods and services. The train tracks will be the form of transportation that connects the city. All coding action bricks must be used in the design. Each group needs to work together to decide the transportation design (circle, Y, or straight line), and where to place different elements of the city.

CLOSING *10 to 15 minutes*

Bring everyone back together. Have each group share their city design.

Ask each group the following questions:

- *What are some of the goods and services your city provides?*
- *Does your city include all the action bricks?*
- *How did your team work together?*
- *Did your team encounter any problem(s)?*
- *If so, how did you solve the problem(s)?*

ENRICHMENT AND NEXT STEPS

Here are some options to consider for additional activities:

- Challenge kids to create a mat to go under the track highlighting the physical features (i.e. water for the port, the gas station). This could be done with paper or material. Encourage kids to be creative.
- Have the group write a story highlighting the attractions found in their city.

LEGO® WEDO 2.0

OVERALL TIME *60-minute lesson*

GROUPS *Two kids per kit*

Next Generation Science Standards: K-2 Engineering Design

Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

ETS1-1

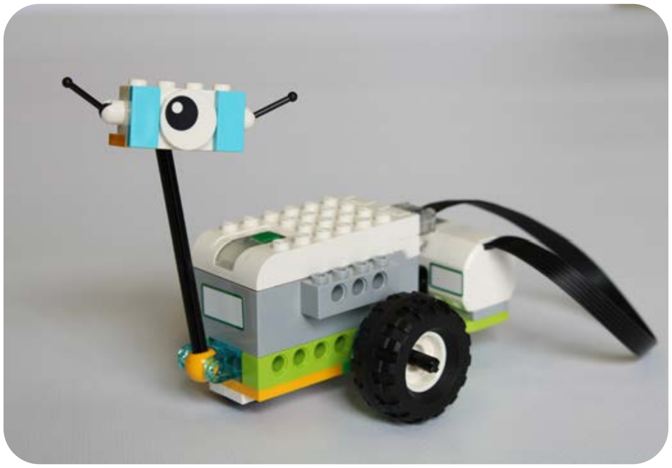
· Ask questions based on observations to find more information about the natural and/or designed world(s).
· Define a simple problem that can be solved through the development of a new or improved object or tool.

ETS1-2

Develop a simple model based on evidence to represent a proposed object or tool.
· Asking questions, making observations, and gathering information are helpful in thinking about problems.
· Before beginning to design a solution, it is important to clearly understand the problem.

OBJECTIVE

Kids will work together to design, build, and code a bot that includes movement.



OVERVIEW

Kids will have the opportunity to work together building on previous LEGO® WeDo 2.0 coding experience to design a bot that moves.

MATERIALS

- **LEGO® WeDo 2.0 set (one per each pair)**
- **Computer or tablet with the WeDo 2.0 app (to download, visit: https://education.lego.com/en-us/support/wedo-2)**
- **Chart paper**
- **Markers**

PREPARATION

Have a blank piece of chart paper located where everyone can view for the launch. Clear an area where groups will test their robot after coding.

LAUNCH *10 to 15 minutes*

To start, have the whole group form a large circle. Ask the group to think of something that moves. Have kids volunteer to share answers. Ask them to describe how the object moves (if time allows, have them demonstrate the movement). Record the list of moving objects on a piece of chart paper.

EXPLORATION *30 to 40 minutes*

Have kids partner up. Tell the group they will be working in pairs to complete a challenge to design, build, and code something that moves. The design can be a form of transportation, an animal, or a robot. Teams will need to come up with an idea or choose one from the list created during the launch.

Allow kids to run bot tests for coding in the area you have available. Share with kids that it is encouraged for teams to watch each other's bots much like engineers collaborate and learn from each other.

Give teams time to design and build their bot. Walk around to each group as they are designing. Possible questions to ask:

- What are your ideas for the design?
- How will your team work together to decide?
- Did everyone contribute?

CLOSING *10 to 15 minutes*

Bring everyone back together. Have each team demonstrate the movement of their WeDo 2.0 robot.

Select a different kid from the group to respond to the following questions:

- *Did your team encounter any problem(s)?*

- *If so, how did you solve the problem(s)?*

ENRICHMENT AND NEXT STEPS

Have the bot move clockwise and counter-clockwise, use motion sensor, or include different power levels.

INTRODUCTION TO 3D PRINTING CONCEPTS

***Note:** *This is an introductory lesson to 3D printing where kids will be observing the 3D printer in action, while their team is creating an object using the Design Process that could later be designed and printed.*

OVERALL TIME *60-minute lesson*

GROUPS *Three to four kids per group*

Next Generation Science Standards

Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

(MS-ETS1-4)

Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

(3-5-ETS1-1)

OBJECTIVE

- **Gain a better understanding of how 3D printing works.**
- **Design and sketch an object that solves a problem.**

OVERVIEW

Kids will learn how a 3D printer works, and what a 3D printer is capable of printing. Kids will design and sketch an object that would be useful to solve a problem in their school using 3D printing to create. Kids will also observe a 3D object being printed.

MATERIALS

- **3D Printer**
- **Downloaded .stl file to print**
- **Playdoh**
- **Paper**

PREPARATION

- Be sure to prepare files for printing using a slicing software such as Cura or Matter Control. The slicing process is an essential part of the printing process to establish the settings for the printer. When you are ready to print, download an object file compatible with your 3D printer.
- Warm up the printer prior to starting the printing process. Be sure the printer is calibrated and the filament is properly fed to the print nozzle.

LAUNCH *10 to 15 minutes*

Bring kids together in a large group. Have them choose a partner and share what they know about 3D printing. After a minute of discussion, have a few pairs share aloud in a large group. Then have the kids choose a different partner and ask where do we see 3D printing in real life? Give a minute for discussion, and then ask a few pairs to share with the group. Some examples might be: prosthetic limbs, toys, vases, replacement parts, prototypes, etc.

Have the kids pair up with a third partner. To begin exploration into 3D printing, have kids take 5 to 10 minutes using the STEM Lab computers to research what can be printed using a 3D printer.

We have several .stl files located on the materials page of the portal.
To download, visit:
http://www.ripkenfoundation.org

EXPLORATION *35 to 40 minutes*

Kids will partner up in groups of 3 to 4, to brainstorm and create a useful object that would be helpful in school such as a door stop, sign holder, or picture frame. Then kids will sketch the design on paper noting different angles of the object (top, bottom, side, etc.). After making the sketches, kids will use Playdoh to create the 3D object.

While kids are working on their design, print an object using the 3D printer. Many of the .stl files found on RipkenFoundation.org only take about 15 minutes, depending on the printer settings.

Have groups come up one at a time to observe the 3D printer in action.

POSSIBLE YOUTUBE VIDEOS

What is 3D printing and how does it work?

- **https://www.youtube.com/watch?v=Llgko_GpXbI**

3D Printing in the Elementary School

- **https://www.youtube.com/watch?v=QTW4r4qfHys**

3D Printing in the Middle School Science Classroom

- **https://www.youtube.com/watch?v=1jp-RemY-_4**

Kids Learn 3D Design and Printing

- **https://www.youtube.com/watch?v=nHgY947uCbU**

CLOSING *5 to 10 minutes*

Bring everyone back together. Have groups share their 3D design and how it would be helpful in school.

Pass around the object that was printed. Have kids share any interesting observations. Take time for teams to thank each other for being a part of their learning community.

ENRICHMENT AND NEXT STEPS

For kids interested in creating their own 3D designs, TinkerCAD is a great website for beginners. TinkerCAD is a free website that allows anyone to learn how to design and print simple or intricate 3D objects. TinkerCAD offers lessons on how to use the controls for the website, as well as how to create designs and objects! Visit **http://www.tinkercad.com** for more information and to access the lessons and design tools.

For additional training and resources, visit **http://ww.mystemkits.com**. Your Robo 3D printer comes with a free, two-hour online training session.

STEM RESOURCES

STEM RESOURCES

These resources listed are websites and products that exist which could assist with facilitation of STEM programming.

CODING AND COMPUTER SCIENCE

Code Academy – learn coding for free

- **http://www.CodeAcademy.com**

Code.org – learn coding and programming with popular characters and games

- **http://www.Code.org**

Scratch Visual, Block-based programming language

- **http://scratch.MIT.edu**

Khan Academy Computer Science Courses

- **http://www.KhanAcademy.org/CS**

CodeCombat.com - game using coding principles, free and paid versions

- **http://www.CodeCombat.com**

Mozilla Thimble – online code editor teaching HTML, CSS, and JavaScript

- **http://https://thimble.mozilla.org/en-US**

AppInventor.org – learn to build Android apps

- **http://www.AppInventor.org**

GameBlox – create and edit games with code

- **http://gameblox.org**

MIT App Inventor

- **http://appinventor.mit.edu/explore**

ROBOTICS

Robotics activities come in all shapes and sizes. Here are a few resources to research if interested in starting a robotics program!

LEGO Mindstorms

SeaPerch

NASA Robotics

- **http://nasa.gov/audience/foreducators/robotics http://robotics.nasa.gov**

Sphero

VEX Robotics

3-D PRINTING

TinkerCAD – online 3D design program. Offers free lessons and design tools

- **http://www.TinkerCAD.com**

Thingverse – website with 3D design files to download and print on your own

- **http://www.Thingiverse.com**

Tinkerine U – online lessons to introduce 3D printing. Has challenges and ideas for kids to design

- **http://www.u.tinkerine.com**

SketchUp – 3D design software, has both a free and paid version

- **http://www.SketchUp.com**

Biological and Earth Sciences

Howard Hughes Medical Institute

- **www.hhmi.org/biointeractive**

EarthWatch Institute

- **http://earthwatch.org/Education**

Earth Science Activities & Experiments

- **http://www.Education.com/activity/earth-science**

MATH

MathChip – math games and activities

- **http://www.MathChimp.com**

STEMCollaborative.org – math games

- **http://www.STEMCollaborative.org**

Adventures in Math

- **http://www.scholastic.com/regions**

Math Playground – math games and activities

- **http://www.MathPlayground.com**

MathSnacks.com – math games and videos

- **http://mathsnacks.com/**

TECHNOLOGY AND ENGINEERING

Engineering.com – news and articles related to engineering

- **http://www.Engineering.com**

Rube Goldberg Challenges – create elaborate inventions to accomplish a simple task!

- **http://www.RubeGoldberg.com**

Engineering is Elementary – lessons and activities for educators available for purchase

- **http://www.eie.org**

TryEngineering.org – information and lesson plans related to engineering

- **http://www.TryEngineering.org**

TeachEngineering.org – lesson plans and activities that tie into the Next Generation Science Standards

- **http://www.TeachEngineering.org**

PHYSICAL AND CHEMICAL SCIENCES

PhysicsGames.net – games related to physics

- **http://www.Physicsgames.net**

Science Kids – simple experiments and activities

- **http://www.ScienceKids.co.nz/physics.html**

myPhysicsLab.com – interactive online physics simulations

- **http://www.MyPhysicsLab.com**

Algodoo – free physics simulation software

- **http://www.algodoo.com**

ChemCollective.org – online simulations and experiments related to chemistry

- **http://www.chemcollective.org/**

GENERAL STEM RESOURCES

STEM Works – articles, activities, and information about all things STEM!

- **http://www.STEM-works.com**

New Mexico State University Learning Games Lab- fun and educational games on a variety of topics

- **http://www.LearningGamesLab.org**

4-H National Youth Science Experiment – a new experiment released annually related to various STEM concepts

- **http://www.4-h.org/NYSD**

Magic School Bus – games, activities, and stories on a wide variety of topics

- **http://www.Scholastic.com/MagicSchoolBus**

National Geographic Kid's Website

- **http://Kids.NationalGeographic.com**

IXL.com – quizzes and activities to reinforce concepts and skills across disciplines. A preview is free but full site use requires subscription

- **http://www.ixl.com**

PBS – The Public Broadcasting Service has several pages related to education and learning

- **http://www.PBSLearningMedia.org**
- **http://www.PBSKids.org/DesignSquad**
- **http://www.PBSKids.org/**

BrainPOP – online educational videos and games. Some videos and games are free, but most require a subscripton

- **http://www.BrainPOP.com**
- **http://www.brainpop.com/games/**

Makerspace.com – Online community for the Maker movement of invention and creativity. Get and share ideas of what to create and make next!

- **http://www.MakerSpace.com**

SEA Research's STEM Mentoring Program

- **http://stemmentoringprogram.org/**

Common Sense Media – resource with ratings and information on various technology media such as games, cyber safety, and other web resources

- **https://www.commonsensemedia.org/**

You are on the front lines, empowering kids in your community each and every day. You're there through life's challenges, just as Cal Ripken, Sr. was for his kids and his players: teaching them how to make the best of every situation, leading by example, and encouraging them to swing for the fences.

At the Cal Ripken, Sr. Foundation, we see our role as supporting you in this shared mission. This guidebook is just a stepping-stone to start your STEM program! We hope you find ways to expand and keep your program going in perpetuity. Here are some resources to encourage program growth.

ADDITIONAL CAL RIPKEN, SR. FOUNDATION RESOURCES

For more information about the Cal Ripken Sr. Foundation, visit our website at

- **http://www.ripkenfoundation.org**

Follow us on twitter at **http://www.twitter.com/CalRipkenSrFdn**

Find us on Facebook at **http://www.facebook.com/CalRipkenSrFdn**

Check out our YouTube Channel at **http://www.youtube.com/CalRipkenSrFdn**

ACKNOWLEDGEMENTS

We would like to thank all of our sponsors for their support.

ANNUAL IMPLEMENTATION PLANS

K-2 Engineering Design

K-2 ETS1-1	Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
K-2 ETS1-2	Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
K-2 ETS1-3	Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Science and Engineering Practices

K-2 ETS1-1	Asking Questions and Defining Problems
K-2 ETS1-2	Developing and Using Models
K-2 ETS1-3	Analyzing and Interpreting Data

Disciplinary Core Ideas

K-2 ETS1.A	Defining and Delimiting Engineering Problems
K-2 ETS1.B	Developing Possible Solutions
K-2 ETS1.C	Optimizing the Design Solution

Crosscutting Concepts

Patterns
Scale, Proportion, and Quantity
Structure & Function

Kindergarten STEM Lessons

Kindergarten STEM Lessons	Minutes
CODE HOPPER	
Code Hopper	60-120
BEE-BOT	
Bee-Bot and/or Bee-Bots Diorama Storyboard	60-180
MAKEY MAKEY	
Makey Makey Introduction Lesson K-2 Basic Circuitry	60
Makey Makey K-2 Block Coding	60-120
ROK BLOCKS	
Kid Spark — It's All About the Blocks!	
Yellow Block	30-40
Little Blue Block	30-40
Angled Red Block	30-40
Medium Green Block	30-40
Kid Spark — I Am an Engineer!	
What Is an Engineer?	30-40
Patterns & Pyramids	30-40
What's in The Lab?	30-40
Free Build	30-40
OZOBOTS	
Ozobot and Ozocodes Intro.	60
Basic Training Color Codes Lesson 1 and 2	100
Hungry Hungry Ozobot	45
I See Ozobot Sees	45
Code a Story — There Was a Cold Lady	45
SQUISHY CIRCUITS	
Squishy Circuits Conductive Creations (consider having cross-grade buddies)	60
3D PRINTING	
Introduction to 3D Printing Concepts	60
	895-1215

**This is an estimated amount of time for these lessons, it could be more or less depending upon kids' needs. Indicates Cal Ripken, Sr. Foundation STEM Lesson. All other lessons are created by the manufacturer of these STEM products.*

Common Core State Standard Connections
ELA/Literacy-
SL.K.1 Participate in collaborative conversations with diverse partners about kindergarten topics.
W.K.2 Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.
Math-
K.G.1 Describe objects in the environment using names of shapes.
K.G.3 Identify shapes as two-dimensional or three-dimensional.
K.CC.5 Count to answer “how many?”

K-2 Engineering Design Performance Expectations

K-2 ETS1-1	Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
K-2 ETS1-2	Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
K-2 ET1-3	Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Science and Engineering Practices

K-2 ETS1-1	Asking Questions and Defining Problems
K-2 ETS1-2	Developing and Using Models
K-2 ETS1-3	Analyzing and Interpreting Data

Disciplinary Core Ideas

K-2 ETS1.A	Defining and Delimiting Engineering Problems
K-2 ETS1.B	Developing Possible Solutions
K-2 ETS1.C	Optimizing the Design Solution

Crosscutting Concepts

Patterns
Cause & Effect: Mechanism & Explanation
Scale, Proportion, and Quantity
Systems & System Models
Structure & Function

First Grade STEM Lessons	Minutes
CODE HOPPER	
Code Hopper	60-120
BEE-BOT	
Bee-Bot and/or Bee-Bots Diorama Storyboard	60-180
MAKEY MAKEY	
Makey Makey Introduction Lesson K-2 Basic Circuitry	60
Makey Makey K-2 Block Coding	60-120
Makey Makey Music and Fun!	60-120
OZOBOTS	
OzoBlockly Basic Training	40
Basic Training Color Codes Lesson 3 & 4	100
Write Your Name with Ozocodes	30
Ozo Expedition	30-45
Create	60-300
ROK BLOCKS	
Introduction to ROK Blocks	60
Kid Spark — Is It Strong?	
How Much Load Can It Hold?	30
The Long Haul	30
Make Your Castle Strong	30
Free Build	30-40
Kid Spark — Does It Move?	
Pushes & Pulls	30-40
Exploring Gravity	30-40
Make Your Castle Strong	30-40
Free Build	30-40
SQUISHY CIRCUITS	
Squishy Circuits Conductive Creations	60
3D PRINTING	
Introduction to 3D Printing Concepts	60+
	1010-1635

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Common Core State Standard Connections
ELA/Literacy-
SL1.1 Participate in collaborative conversations with diverse partners about grade 1 topics.
SL1.5 Add drawings or other visual displays to descriptions when appropriate to clarify ideas, thoughts, and feelings.
Math-
1.G.2 Compose two-dimensional shapes or three-dimensional shapes to create a composite shape, and compose new shapes from the composite shape.

K-2 Engineering Design Performance Expectations

K-2 ETS1-1	Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
K-2 ETS1-2	Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
K-2 ETS1-3	Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Science and Engineering Practices

K-2 ETS1-1	Asking Questions and Defining Problems
K-2 ETS1-2	Developing and Using Models
K-2 ETS1-3	Analyzing and Interpreting Data

Disciplinary Core Ideas

K-2 ETS1.A	Defining and Delimiting Engineering Problems
K-2 ETS1.B	Developing Possible Solutions
K-2 ETS1.C	Optimizing the Design Solution

Crosscutting Concepts

Patterns
Cause & Effect: Mechanism & Explanation
Scale, Proportion, and Quantity
Systems & System Models
Structure & Function

Second Grade STEM Lessons	Minutes
CODE HOPPER	
Code Hopper	60-120
BEE-BOT	
Bee-Bot and/or Bee-Bot Diorama Storyboard	60-120
MAKEY MAKEY	
Makey Makey Introduction Lesson K-2 Basic Circuitry	60
Makey Makey K-2 Block Coding	60-120
Makey Makey Music and Fun!	60-120
ROK BLOCKS	
Introduction to ROK Blocks	60
Making Things Move	180
See Like a Designer, Think Like an Engineer	120
Make Things Strong	60
Design Perspectives	60
OZOBOTS	
OzoBlocky Basic Training	40
Basic Training Color Code Lessons	50-200
Mission to Mars	45
100 cm Ozo-Dash	30-60
President's Parade	30
Ozobot Dance Off	60
OzoBlocky Skills 1	45-55
OzoBlocky Skills 2	45-55
OzoBlocky Skills 3	50
OzoBlocky Skills 4	35-50
OzoBlocky Skills 5	35-50
SQUISHY CIRCUITS	
Sculpting Your First Circuit	35-60
Series & Parallel Circuits	35-60
Challenge Time	35-60
3D PRINTING	
Introduction to 3D Printing Concepts	60+

SNAP CIRCUITS	
Snap Circuits Electric Bingo	60
	1440-2105

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Common Core State Standard Connections

ELA/Literacy-

SL.2.1 Participate in collaborative conversations with diverse partners about grade 2 topics.

L.2.5a Identify real-life connections between words and their use.

Math-

2.MD.3 Estimate lengths using units.

3-5 Engineering Design Performance Expectations

3-5 ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time or cost.
3-5 ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
3-5 ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Science and Engineering Practices

3-5 ETS1-1	Asking Questions and Defining Problems
3-5 ETS1-2	Planning and Carrying Out Investigations
3-5 ETS1-3	Constructing Explanations and Designing Solutions

Disciplinary Core Ideas

3-5 ETS1.A	Defining and Delimiting Engineering Problems
3-5 ETS1.B	Developing Possible Solutions
3-5 ETS1.C	Optimizing the Design Solution

Crosscutting Concepts

Patterns
Cause & Effect: Mechanism & Explanation
Scale, Proportion, and Quantity
Systems & System Models
Structure & Function

Third Grade STEM Lessons	Minutes
MAKEY MAKEY	
Makey Makey Introduction Lesson 3-5 Basic Circuitry	60
Makey Makey 3-5 Block Coding	60-120
Makey Makey Music and Fun!	60-120
OZOBOT	
Ozobot Bowl-O-Rama	60
OzoBlocky Basic Training	25-50
Basic Training Color Code Lessons	50-150
Ellipses & Celestial Mechanics	45-55
Modeling Animal Habitats	30-60
ROK BLOCKS	
Kid Sparks- Engineering Basics w/ROK Blocks	
Introduction to ROK Blocks	60
Mechanisms	120-180
The Design & Engineering Process	120
ROK Blocks Cargo Racer Challenge	60-75
SNAP CIRCUITS	
Snap Circuits Electric Bingo	60
Get Snapped with Snap Circuits 3	60-120
SQUISHY CIRCUITS	
Squishy Circuits Conductive Creations	60
3D PRINTING	
3D Printing	60 +
LITTLEBITS	
Introduction to littleBits: Input Circuits	60
Introducing the littleBits: Invention Cycle	60
Invent an Art Machine	60-120
Invent a Chain Reaction Contraption	120+
Constellation Viewer	60
Speed Racer	60
Environmental Sign	45
Inherited Traits	45

littleBits Engineering Design	60-90
	1560-2070

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Common Core State Standard Connections
ELA/Literacy-
L.3.5b Identify real-life connections between words and their use.
SL3.1 Engage effectively in a range of collaborative discussions with diverse partners on grade 3 topics and texts, building on other's ideas and expressing their own clearly.
Math-
3.MD.5 Recognize area as an attribute of plane figures and understand concepts of area measurement.

3-5 Engineering Design Performance Expectations

3-5 ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time or cost.
3-5 ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
3-5 ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Science and Engineering Practices

3-5 ETS1-1	Asking Questions and Defining Problems
3-5 ETS1-2	Planning and Carrying Out Investigations
3-5 ETS1-3	Constructing Explanations and Designing Solutions

Disciplinary Core Ideas

3-5 ETS1.A	Defining and Delimiting Engineering Problems
3-5 ETS1.B	Developing Possible Solutions
3-5 ETS1.C	Optimizing the Design Solution

Crosscutting Concepts

Patterns
Cause & Effect: Mechanism & Explanation
Scale, Proportion, and Quantity
Systems & System Models
Structure & Function

Fourth Grade STEM Lessons

Fourth Grade STEM Lessons	Minutes
MAKEY MAKEY	
Makey Makey Introduction Lesson 3-5 Basic Circuitry	60
Makey Makey 3-5 Block Coding	60-120
Makey Makey Music and Fun!	60-120
SQUISHY CIRCUITS	
Squishy Circuits Conductive Creations	60
SNAP CIRCUITS	
Snap Circuits Electric Bingo	60
Get Snapped with Snap Circuits 4	60-120
ROK BLOCKS	
Introduction to ROK Block (if needed)	60
ROK Blocks Engineering Design Challenge 2	60-90
Making Things Move	180
OZOBOT	
OzoBlocky Basic Training	25-50
Basic Training Color Codes (3 lessons)	50-150
Elementary School CS with Game Design	200
LESSONS 1-4	
Clean Energy Cruise	30-45
LITTLEBITS	
Busy Bees	60
Heart Beats	60
Chain Reaction Machine	50
Morse Code Devise	45
Energy Transfer	45
Plant Adaptations	60
Fortune Teller	45
Introduction to littleBits	60
Introducing the littleBits Invention Cycle	60
Invent a Self-Driving Vehicle	60-120
Hack Your Classroom	120+

EXTRA LITTLEBITS GENERAL LESSONS	
Turning Points (3 lessons)	135
VocaBilitary (2 lessons)	50-100
Let's Make a Techno Jungle (4 lessons)	200
Aesop's Fables (3 lessons)	135
3D PRINTING	
Introduction to 3D Printing Concepts	60+
	2210-2670

**This is an estimated amount of time for these lessons, it could be more or less depending upon kids' needs. Indicates Cal Ripken, Sr. Foundation STEM Lesson. All other lessons are created by the manufacturer of these STEM products.*

Common Core State Standard Connections
ELA/Literacy-
SL.4.1 Engage effectively in a range of collaborative discussions with diverse partners on grade 4 topics.
W.4.2d Use precise language and domain specific vocabulary to inform about or explain the topic.
Math-
4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.

3-5 Engineering Design Performance Expectations

3-5 ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time or cost.
3-5 ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
3-5 ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Science and Engineering Practices

3-5 ETS1-1	Asking Questions and Defining Problems
3-5 ETS1-2	Planning and Carrying Out Investigations
3-5 ETS1-3	Constructing Explanations and Designing Solutions

Disciplinary Core Ideas

3-5 ETS1.A	Defining and Delimiting Engineering Problems
3-5 ETS1.B	Developing Possible Solutions
3-5 ETS1.C	Optimizing the Design Solution

Crosscutting Concepts

Patterns
Cause & Effect: Mechanism & Explanation
Scale, Proportion, and Quantity
Systems & System Models
Structure & Function

Fifth Grade STEM Lessons

Fifth Grade STEM Lessons	Minutes
MAKEY MAKEY	
Makey Makey Introduction Lesson 3-5 Basic Circuitry	60
Makey Makey 3-5 Block Coding	60-120
Makey Makey Music and Fun Challenge	60-75
SNAP CIRCUITS	
Snap Circuits Electric Bingo	60
Get Snapped with Snapped Circuits 5	60-120
3D PRINTING	
Introduction to 3D Printing Concepts	60
ROK BLOCKS	
Introduction to ROK Block (if needed)	60
ROK Creek Bridge	180
Kid Sparks-Applied Mathematics ROK Blocks	
Dimension & Measurement	60-90
Perimeter	60-90
Area	60-90
Volume	60-90
Ratios, Proportions, and Scale Drawings	60-90
OZOBOTS	
OzoBlocky Basic Training (if needed)	25-50
Basic Training Color Codes (if needed)	50-150
Space Exploration Game	180
EVO The Troll	55
Elementary School CS with Game Design	50-100
Game Design Supplementary Lesson	
LITTLEBITS	
Introduction to littleBits: Servo Circuits	60
Invent a Throwing Arm	60-120
Invent for Good	120+
Introducing the littleBits Invention Cycle	60

LITTLEBITS STEAM STUDENT SCIENCE LESSONS	
Keep It Cool	90
Ecosystem Dynamics	60
Snack Robot	45
Lunar Phases	60
EXTRA LITTLEBITS GENERAL LESSONS	
Turning Points (3 lessons)	135
VocaBilitary (2 lessons)	50-100
Let's Make a Techno Jungle (4 lessons)	200
Aesop's Fables (3 lessons)	135
	2335-2845

**This is an estimated amount of time for these lessons, it could be more or less depending upon kids' needs. Indicates Cal Ripken, Sr. Foundation STEM Lesson. All other lessons are created by the manufacturer of these STEM products.*

Common Core State Standard Connections

ELA/Literacy-

SL.5.1 Engage effectively in a range of collaborative discussion with diverse partners on grade 5 topics.

SL.5.1d Review the key ideas expressed and draw conclusion in light of information and knowledge gained from the discussions.

Math-

5.MD.3 Recognize volume as an attribute of solid figures and understand concepts of volume measurement.

Printing of the Ripken Foundation STEM Center Curriculum Guidebook provided by

BATTELLE

Thanks to Southwest Airlines for funding the 2020 Ripken Foundation STEM Challenge.

The Ripken Foundation STEM Challenge provides youth at Ripken Foundation STEM Centers an opportunity to participate in a national competition. Using a real-world scenario, youth apply STEM skills and knowledge to develop innovative solutions to a designated problem.

The challenge topic changes on an annual basis with roots in a STEM-related field and provides context for the teams with regard to variables they need to consider in their approach to solving the problem. This exercise in teamwork teaches more than just STEM principles. By competing in this event kids gain valuable life skills which include critical thinking, problem-solving, teamwork, and communication, as well as using resources efficiently. Look for the prompt to be released in August 2020 from your Program Coordinator to participate in this year's Ripken Foundation STEM Challenge!

CAL RIPKEN, SR. Foundation

TRANSFORM COMMUNITIES
CHANGE KIDS' LIVES

The Cal Ripken, Sr. Foundation helps to build character and teach critical life lessons to at-risk young people living in America's most distressed communities.